United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
the Research Division of
the College of Agricultural
and Life Sciences,
University of Wisconsin

Soil Survey of Marinette County, Wisconsin

How To Use This Soil Survey

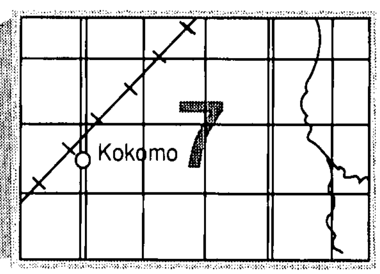
General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

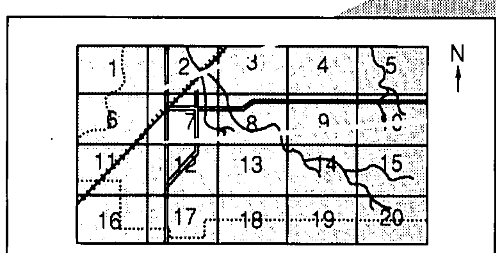
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.



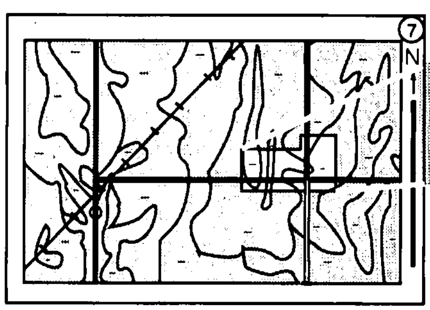
MAP SHEET

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

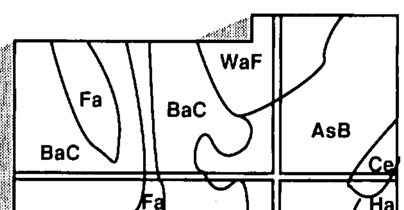


INDEX TO MAP SHEETS

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1986. Soil names and descriptions were approved in 1987. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1987. This survey was made cooperatively by the Soil Conservation Service and the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin. It is part of the technical assistance furnished to the Marinette County Land Conservation Committee, which helped finance the fieldwork.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Waterfall on the Pike River.

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Issued February 1991

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Marinette County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

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Soil Survey of Marinette County, Wisconsin

By Howard E. Lorenz, Soil Conservation Service

Fieldwork by Terry L. Kroll, Charles F. Leonard, Howard E. Lorenz, Ronald W. Luethe, Robert D. Weihrouch, and Charles E. Wilkinson, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with the
Research Division of the College of Agricultural and Life Sciences, University of Wisconsin

MARINETTE COUNTY is in the northeastern part of Wisconsin (fig. 1). It is entirely within the drainage basins of the Peshtigo and Menominee Rivers and has a total area of 916,051 acres. Of this total, about 893,011 acres is land and 23,040 acres is water areas of more than 40 acres. The city of Marinette is the largest community in the county and is the county seat. It had a population of 12,696 in 1980. Wood-using industries and lumbering are major enterprises. Dairy farming is the major agricultural enterprise. Outdoor recreation is also an important industry.

This survey updates the soil survey of Marinette County published in 1916 *(17)*. It provides additional information and larger, more detailed soil maps. The soil names may differ from those in the earlier survey because of a better knowledge of the soils and changes in soil concepts.

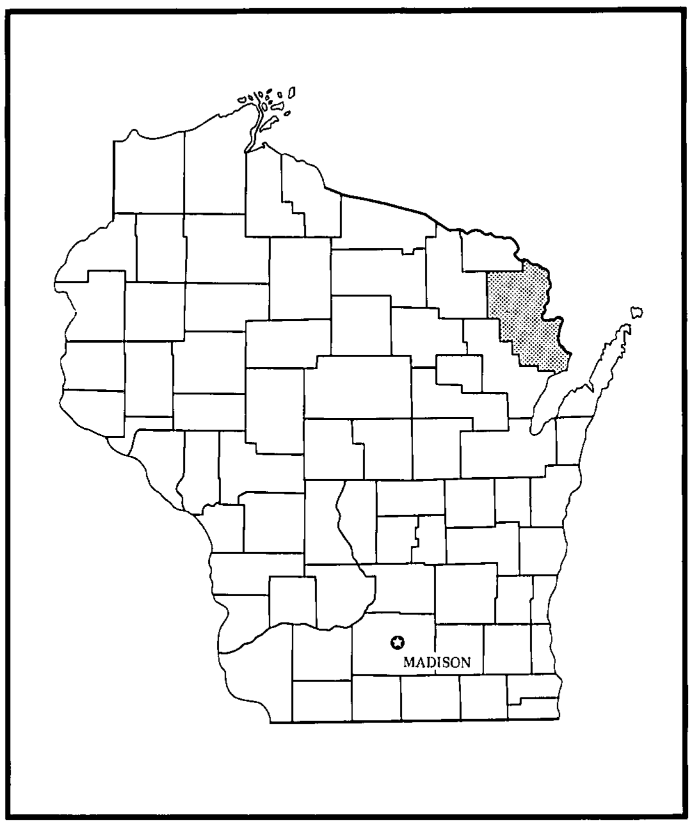

Figure 1.—Location of Marinette County in Wisconsin.

General Nature of the County

This section describes some physical and cultural characteristics of the county. Physical characteristics include climate; physiography, relief, and drainage; and water supply. Cultural factors are history and development, transportation, and industry. The geology and underlying material are described under "Formation of the Soils."

Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

Winters in Marinette County are very cold, and the short summers are fairly warm. The short freeze-free period during the summer limits cropping mainly to corn, small grain, forage, and some vegetables. Precipitation is fairly well distributed throughout the year, reaching a slight peak in summer. Snow covers the ground much of the time from late fall through early spring.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Goodman, Wisconsin, in the period 1959 to 1981. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 15 degrees F and the average daily minimum temperature is 3 degrees. The lowest temperature on record, which occurred at Goodman on January 15, 1972, is -33 degrees. In summer, the average temperature is 64 degrees and the average daily maximum temperature is 76 degrees. The highest recorded temperature, which occurred on July 20, 1977, is 96 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 31 inches. Of this, more than 21 inches, or about 70 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 17 inches. The heaviest 1-day rainfall during the period of record was 3.55 inches at Goodman on May 13, 1962. Thunderstorms occur on about 34 days each year.

The average seasonal snowfall is about 52 inches. The greatest snow depth at any one time during the period of record was 42 inches. On the average, 113 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 65 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 45 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 12 miles per hour, in spring.

Physiography, Relief, and Drainage

The physiography, relief, and drainage of the county are primarily the result of glaciation. Within Marinette County there are three major physiographic regions *(4)*. The western and northern sections are in the Northern Highlands region. The central section of the county is part of the Wisconsin Central Plain. The southeast part of the county is in the Eastern Ridges and Lowlands physiographic region.

The elevation ranges mainly from about 1,400 feet above sea level in the northwestern part of the county to about 580 feet above sea level at the shoreline of Green Bay in the southeast corner of the county. The highest elevation is McCaslin Mountain, which is 1,670 feet above sea level.

The surface water in Marinette County flows primarily to the southeast and eventually to Green Bay. The Peshtigo River is a major drainageway which flows southeast where it enters Green Bay. Other major drainages are the Pemebenwon, Pike, and Wausaukee River systems, which are part of the Menominee River watershed. The Menominee River, which is the eastern boundary of the county, also flows into Green Bay.

The secondary drainage system is poorly developed throughout most of the county. Much of the surface runoff flows into basins and depressions where it tends to accumulate and is released slowly to streams. Many basins do not have surface outlets.

Water Supply

The many lakes, streams, and rivers in the area furnish an abundant supply of surface water. In most areas of the county ground water is adequate to meet the needs of domestic, agricultural, municipal, and industrial users.

Ground water is stored in porous strata called aquifers. It is available at various depths, depending upon the general topography, the distance above the permanent stream level, and the character of the underlying rock formation. The southeastern third of the county is underlain by the Potsdam sandstone, Saint Peter sandstone, and Lower Magnesian and Trenton limestone formations, which are good aquifers. The northwestern two-thirds of the county is underlain by igneous and metamorphic bedrock that yields little or no

Figure 2.—One of the many wilderness lakes that provide water-based recreation in Marinette County.

water. In both areas the overlying glacial deposits are aquifers.

The glacial-deposit aquifers are mainly in outwash, stratified sand and gravel deposits, or ice-contact deposits *(12)*. They are highly permeable and yield large quantities of water to wells. Most high capacity wells in these aquifers are 30 to 308 feet deep. The wells yield as much as 1,000 gallons per minute.

The sandstone bedrock aquifers in the southeastern part of the county have wells that range from 41 to 1,005 feet deep. They yield from 10 to 1,260 gallons per minute.

The ground water in Marinette County is generally of good quality. Nearly all the water is moderately hard to hard and is principally a calcium magnesium bicarbonate type. Iron is in many wells but is not considered a health problem.

Marinette County has many lakes (fig. 2). The largest is Lake Noquebay, which is 2,162 acres. The deepest is Gilas Lake, which has a maximum depth of 84 feet. The largest impoundment is High Falls Flowage, which is 1,498 acres. It is also the deepest, 57 feet. There are a total of 56 wilderness lakes in the county. They are at least 5 acres each. Some of the major wilderness lakes are Campbell, Hazel, Phillips, and Pothole.

Streams in the county have a total length of 918

miles, of which 614 miles is classed as trout waters. The Menominee River is the largest stream in the county. The Pike River is one of the three Wisconsin Rivers designated as wild rivers by the Wisconsin Department of Natural Resources. Power dams along some rivers hold some of the surface water in the county and serve as a means of flood control.

History and Development

The first white settler in the Marinette area was Louis Chappee, or Chappieu, who came as a representative of the American Fur Company in 1796 *(3)*. He had a monopoly on the fur trade for more than 25 years until William Farnsworth and Charles Brush arrived. Chappee eventually moved to an area near the rapids which now bear his name.

In 1832, Farnsworth and Brush constructed the first sawmill on the Menominee River. In 1866, a company was formed to organize the various lumbermen to float logs down the Menominee River. From 1866 to 1917, the company built 44 dams on the Menominee River and its tributaries to control water. It floated more than 10.5 billion board feet of lumber to sawmills in the cities of Marinette and Menominee. In 1895, there were 22 sawmills on the Menominee River. Other lumbering centers in the county were in the villages of Peshtigo, Peshtigo Harbor, Wausaukee, and Dunbar. The pine lumber from these mills was shipped on schooners to Chicago and then by rail to the treeless prairie states for building homes, barns, and fences.

The quarrying of rock was also an early enterprise. Granite quarries in the Amberg and Athelstane areas furnished building materials for much of the turn-of-the-century construction in many large cities across the United States.

The first farmer in Marinette County was John Kittson, who built a home near the Menominee River in 1830. By 1850, there were 579 acres of cultivated land between the Menominee and Peshtigo Rivers. Farming continued to grow in importance as the timber resources were depleted.

Transportation and Industry

The major north-south auto routes through Marinette County are U.S. Highways 41 and 141. The east-west routes are State Highway 64 and U.S. Highway 8. The county also maintains an extensive network of county highways. In addition, the county has about 206 miles of forest and park roads that provide access for logging and recreation in the county's parks and forests. The county is also served by three freight railroads.

Air transportation is provided by the Crivitz Municipal Airport and by the Twin County Airport in Menominee, Michigan.

The only port in Marinette County is in Marinette. This port handles a small percentage of the area's freight and some tourism traffic.

Manufacturing industries, producing chemical fire extinguishing agents, cutting tools, farm material handling equipment, foundry products, furniture, and electrical wiring harnesses for automobiles, provide about 40 percent of the employment in the county. About 23 percent is provided by lumber and related wood products industries. Another 17 percent is provided by various units of government *(7)*.

Dairy farming is the major agricultural enterprise in Marinette County. There is also some beef and veal production. As is common throughout the state, the number of farms in the county is decreasing and the average size of farms is increasing.

The tourism and recreation industry has long been an important part of the economy in Marinette County. The numerous lakes and streams and large acreages of county-owned forests provide facilities for camping, hiking, swimming, fishing, and boating. Numerous white-tailed deer, many of which inhabit public land, attract many hunters during the hunting season. A good population of trout and salmon in the waters of Green Bay attract many fishermen for deep-water fishing. Winter usually provides snow for snowmobiles and cross-country skiing.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms,

relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small

areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The associations in Marinette County join with similar associations that may have different names in adjacent counties. These differences occur because of changes in the classification of two series and because laboratory data indicate that the soils that formed in glacial till in Marinette County average slightly less clay in the subsoil than do similar soils in adjacent counties. Other differences result from variations in the pattern of occurrence of the major soils in the different counties. None of the differences significantly affects the use of the maps for general planning.

Soil Descriptions

Areas Dominated by Soils That Formed in Glacial Till

This group of associations makes up about 23 percent of the county. The soils are nearly level to steep. They formed mainly on moraines and drumlins. They are well drained and somewhat poorly drained.

Most areas of this group are used as cropland. Corn, small grain, and hay are the main crops. Some areas are used as woodland.

Erosion and wetness are the main limitations in managing these soils as cropland, pasture, or woodland. Wetness, excessive slope, and depth to dolomite are the main limitations affecting building site development, sanitary facilities, and recreational development.

1. Emmet-Charlevoix Association

Deep, nearly level to steep, well drained and somewhat poorly drained, loamy soils on moraines and drumlins

Areas of these soils are on ground moraines and drumlins that are dissected by drainageways. The drumlins are generally oriented from northeast to southwest. Slopes range from 0 to 30 percent.

This association makes up about 11 percent of the county. It is about 50 percent Emmet soils, 25 percent Charlevoix soils, and 25 percent soils of minor extent (fig. 3).

Emmet soils are on broad ridgetops and the side slopes of ridges. They are well drained. Slope ranges from 1 to 30 percent. Permeability is moderate in the upper part of the soils and moderate or moderately rapid in the lower part. The available water capacity is moderate. Typically, the surface layer is very dark gray, very friable fine sandy loam about 3 inches thick. The subsurface layer is pinkish gray, very friable fine sandy loam about 1 inch thick. The upper part of the subsoil is brown, very friable fine sandy loam about 6 inches thick. The next 8 inches is light brownish gray and dark reddish brown, very friable and firm fine sandy loam. The lower part of the subsoil is dark reddish brown and yellowish red, friable fine sandy loam about 15 inches thick. The substratum to a depth of about 60 inches is reddish brown fine sandy loam.

Charlevoix soils are in depressions and drainageways. They are somewhat poorly drained. Slope ranges from 0 to 6 percent. Permeability is moderate or moderately rapid. The available water capacity is high. Typically, the surface layer is black, very friable fine sandy loam about 4 inches thick. The subsurface layer is light brownish gray, mottled, very friable fine sandy loam about 2 inches thick. The subsoil is mottled. The upper part is brown, very friable

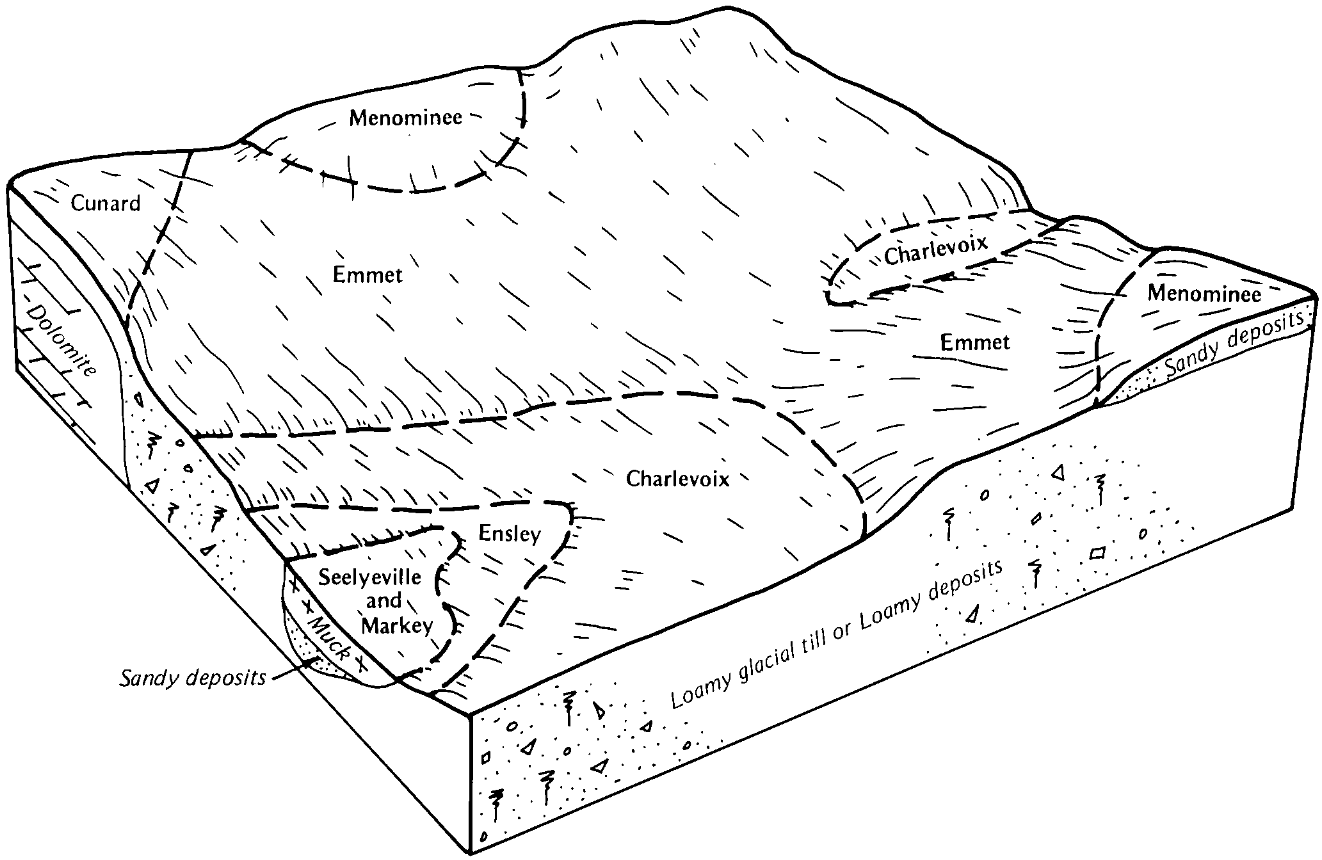

Figure 3.—Pattern of soils and parent material in the Emmet-Charlevoix association.

fine sandy loam about 4 inches thick. The next 6 inches is brown, friable fine sandy loam. The lower part is 4 inches of brown, friable loam and 3 inches of reddish brown, very friable sandy loam. The substratum to a depth of about 60 inches is reddish brown, mottled sandy loam.

Some of the soils of minor extent in this association are the Cunard, Ensley, Markey, Menominee, and Seelyeville soils. The well drained Cunard soils are on ridges. They formed in loamy deposits underlain by dolomite at a depth of 20 to 40 inches. The poorly drained and very poorly drained Ensley soils formed in loamy deposits in depressions and drainageways. The very poorly drained, organic Markey and Seelyeville soils are in depressions and drainageways. The well drained Menominee soils are on ridges and the side slopes of ridges. They formed in sandy deposits and in the underlying loamy deposits.

Most areas of this association are used for crops or pasture. The less sloping areas of the Emmet soils and drained areas of the Charlevoix soils are suited to crops and pasture. The main concerns in managing the Emmet soils for crops and pasture are controlling water erosion and maintaining fertility. Wetness is the main concern in managing the Charlevoix soils.

Some areas of this association are used as woodland. The main concerns in managing the Emmet soils are equipment limitations, which are caused by low soil strength during wet periods and by the slope. Wetness and low soil strength are concerns in managing the Charlevoix soils. The windthrow of trees, which results from a shallow rooting depth, also is a management concern in areas of the Charlevoix soils.

The less sloping areas of the Emmet soils are suited to dwellings. They are only moderately suited to septic tank absorption fields because of moderate permeability. The Charlevoix soils are poorly suited to dwellings and septic tank absorption fields because of the wetness.

2. Menominee-Emmet Association

Deep, nearly level to steep, well drained, sandy and loamy soils on outwash plains, moraines, and drumlins

Areas of these soils are on water-worked moraines, drumlins, and outwash plains. The moraines range from broad, flat areas to irregularly shaped ridges. The drumlins are primarily oriented from northeast to southwest, but they are oriented from east to west in some areas. Slopes range from 1 to 30 percent.

This association makes up about 2 percent of the county. It is about 40 percent Menominee soils, 30 percent Emmet soils, and 30 percent soils of minor extent.

Menominee soils are on ridgetops and the side slopes of ridges. They are well drained. Slope ranges from 2 to 25 percent. Permeability is rapid in the sandy upper part of the profile and moderate in the loamy lower part of the subsoil and in the substratum. The available water capacity is moderate. Typically, the surface layer is very dark grayish brown, very friable loamy sand about 8 inches thick. The upper part of the subsoil is brown and strong brown, very friable sand about 22 inches thick. The next 6 inches is brown, friable loamy sand. The lower part of the subsoil is brown and strong brown, friable fine sandy loam about 14 inches thick. The substratum to a depth of about 60 inches is brown fine sandy loam.

Emmet soils are on ridgetops and on the side slopes of ridges. They are well drained. Slope ranges from 1 to 30 percent. Permeability is moderate in the upper part of the soils and moderate or moderately rapid in the lower part. The available water capacity is moderate. Typically, the surface layer is very dark gray, very friable fine sandy loam about 3 inches thick. The subsurface layer is pinkish gray, very friable fine sandy loam about 1 inch thick. The upper part of the subsoil is brown, very friable fine sandy loam about 6 inches thick. The next 8 inches is light brownish gray and dark reddish brown, very friable and firm fine sandy loam. The lower part of the subsoil is dark reddish brown and yellowish red, friable fine sandy loam about 15 inches thick. The substratum to a depth of about 60 inches is reddish brown fine sandy loam.

Some of the soils of minor extent in this association are the Charlevoix, Ensley, Iosco, Markey, and Seelyeville soils. The somewhat poorly drained Charlevoix and poorly drained and very poorly drained Ensley soils formed in loamy deposits in drainageways and depressions. The somewhat poorly drained Iosco soils are in drainageways and depressions. They formed in sandy deposits and in the underlying loamy deposits. The very poorly drained, organic Markey and Seelyeville soils are in depressions and drainageways.

The major soils in this association are used for crops or as woodland. The less sloping areas of these soils are suited to crops and pasture. The main concerns in managing the Menominee soils for crops and pasture are controlling water erosion and soil blowing and maintaining fertility. Controlling water erosion and maintaining fertility are the main concerns in managing the Emmet soils.

The major soils are suited to trees. The main concerns in managing the Menominee soils for woodland are equipment limitations on the steeper slopes and seedling mortality, which is caused by the droughtiness of the sandy upper layer. The main concerns in managing the Emmet soils are equipment limitations, which are caused by low soil strength during wet periods and by the slope.

The less sloping areas of the Menominee soils are suited to dwellings and septic tank absorption fields. The less sloping areas of the Emmet soils are suited to dwellings. They are only moderately suited to septic tank absorption fields because of moderate permeability.

3. Cunard-Emmet Association

Moderately deep and deep, nearly level to steep, well drained, loamy soils on moraines and drumlins

Areas of these soils are on ground moraines and drumlins where dolomite is relatively close to the surface. Slopes range from 1 to 30 percent.

This association makes up about 1 percent of the county. It is about 40 percent Cunard soils, 30 percent Emmet soils, and 30 percent soils of minor extent.

Cunard soils are on ridges. They are moderately deep and well drained. Slope ranges from 1 to 6 percent. Permeability is moderate. The available water capacity is low. Typically, the surface layer is dark brown, very friable loam about 5 inches thick. The next 6 inches is brown and dark brown, very friable fine sandy loam. The subsoil is about 13 inches thick. It is friable. It is reddish brown loam in the upper part and brown sandy loam in the lower part. The substratum is brown gravelly sandy loam about 5 inches thick. Dolomite is at a depth of about 29 inches.

Emmet soils are on ridgetops and the side slopes of ridges. They are deep and well drained. Slope ranges from 1 to 30 percent. Permeability is moderate in the upper part of the soils and moderate or moderately rapid in the lower part. Typically, the surface layer is very dark gray, very friable fine sandy loam about 3

inches thick. The subsurface layer is pinkish gray, very friable fine sandy loam about 1 inch thick. The upper part of the subsoil is brown, very friable fine sandy loam about 6 inches thick. The next 8 inches is light brownish gray and dark reddish brown, very friable and firm fine sandy loam. The lower part of the subsoil is dark reddish brown and yellowish red, friable fine sandy loam about 15 inches thick. The substratum to a depth of about 60 inches is reddish brown fine sandy loam.

Some of the soils of minor extent in this association are the Bonduel, Charlevoix, Markey, Menominee, Nahma, and Seelyeville soils. The somewhat poorly drained Bonduel and very poorly drained Nahma soils are in depressions and drainageways. They formed in loamy or loamy and silty deposits underlain by dolomite. The somewhat poorly drained Charlevoix soils formed in loamy deposits in depressions and drainageways. The well drained Menominee soils formed in sandy deposits and in the underlying loamy deposits on ridgetops and side slopes. The very poorly drained, organic Markey and Seelyeville soils are in depressions and drainageways.

Most areas of this association are used for crops or pasture. The Cunard soils and the less sloping areas of the Emmet soils are suited to crops and pasture. The main concerns in managing these soils are controlling water erosion and maintaining fertility.

Some areas of this association are used as woodland. The main concerns in managing the Cunard soils for woodland are equipment limitations, which are caused by low soil strength during wet periods, by the slope, and by the moderate depth to dolomite. Because the rooting depth is limited by the underlying dolomite, the windthrow of trees also is a management concern. The main concerns in managing the Emmet soils are equipment limitations, which are caused by low soil strength during wet periods and by the slope.

The Cunard soils are poorly suited to dwellings with basements and to septic tank absorption fields, mainly because of the underlying dolomite. The less sloping areas of the Emmet soils are suited to dwellings. They are only moderately suited to septic tank absorption fields because of moderate permeability.

4. Sarona-Keweenaw Association

Deep, nearly level to steep, well drained, loamy and sandy soils on moraines

Areas of these soils are on ground moraines and end moraines. The moraines are generally oriented from northeast to southwest. The end moraines are irregularly shaped ridges. Slopes range from 1 to 25 percent.

This association makes up about 9 percent of the county. It is about 47 percent Sarona soils, 18 percent Keweenaw soils, and 35 percent soils of minor extent (fig. 4).

Sarona soils are on broad ridges and the side slopes of ridges. They are well drained. Slope ranges from 2 to 25 percent. Permeability and the available water capacity are moderate. Typically, about ½ inch of black, partially decomposed forest litter is at the surface. The surface layer is very dark gray, very friable fine sandy loam about 4 inches thick. The subsurface layer is pinkish gray, friable fine sandy loam about 2 inches thick. The upper part of the subsoil is strong brown, friable fine sandy loam and brown, friable sandy loam about 22 inches thick. The next 3 inches is yellowish red and brown, friable sandy loam. The lower part of the subsoil is reddish brown and dark brown, firm and friable sandy loam about 7 inches thick. The substratum to a depth of about 60 inches is strong brown loamy sand.

Keweenaw soils are on broad ridges and the side slopes of ridges. They are well drained. Slope ranges from 1 to 25 percent. Permeability is moderate or moderately rapid in the upper part of the profile and moderately rapid in the substratum. The available water capacity is low. Typically, about 3 inches of black, decomposed forest litter is at the surface. The surface layer is very dark gray, very friable loamy sand about 4 inches thick. The subsurface layer is grayish brown, very friable loamy sand about 3 inches thick. The subsoil is about 17 inches thick. It is dark brown, friable loamy sand in the upper part and strong brown, very friable loamy sand in the lower part. The next 12 inches is reddish brown, friable sandy loam. The substratum to a depth of about 60 inches is yellowish red loamy sand.

Some of the soils of minor extent in this association are the Goodman, Markey, Monico, Padus, and Seelyeville soils. The well drained Goodman soils formed in silty deposits and in the underlying loamy or sandy deposits on broad ridges and side slopes. The somewhat poorly drained Monico soils formed dominantly in loamy deposits in depressions and drainageways. The well drained Padus soils are on flats, ridgetops, and side slopes. They formed in loamy and sandy deposits underlain by stratified sand or sand and gravel. The very poorly drained, organic Markey and Seelyeville soils are in drainageways and depressions.

Most areas of this association are used as woodland.

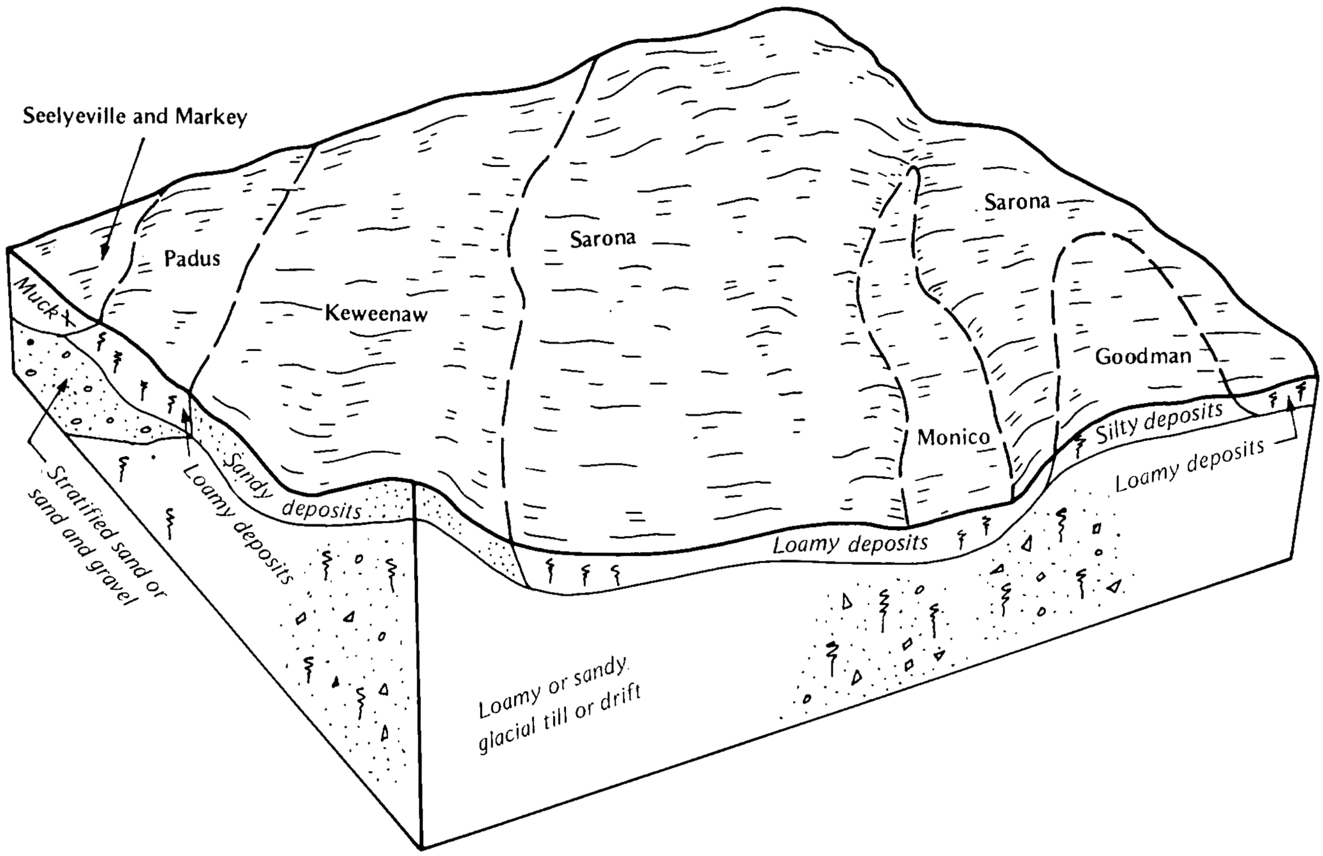

Figure 4.—Pattern of soils and parent material in the Sarona-Keweenaw association.

The main concerns in managing the Sarona soils for woodland are equipment limitations, which are caused by low soil strength during wet periods and by the slope. The main concerns in managing the Keweenaw soils are equipment limitations and the hazard of water erosion on the steeper slopes.

Some areas of this association are used for crops or pasture. The less sloping areas are suited to crops and pasture. The hazard of water erosion is the main management concern. Droughtiness and soil blowing are also hazards on the Keweenaw soils.

The less sloping areas of the major soils are suited to dwellings. They are only moderately suited to septic tank absorption fields because of moderate permeability.

Areas Dominated by Soils That Formed in Glacial Outwash and Till

This group of associations makes up about 68 percent of the county. The soils are nearly level to steep. They formed on a complex topography of moraines, outwash plains, stream terraces, and glacial lake basins. They are excessively drained, somewhat excessively drained, well drained, somewhat poorly drained, poorly drained, and very poorly drained.

Most areas of this group are used as woodland. Some of the less sloping areas are used as cropland or pasture. The undrained wet soils are used as wildlife habitat.

Erosion, soil blowing, and droughtiness are the main limitations in managing these soils as woodland, cropland, or pasture. Excessive slope is the main limitation affecting building site development. Rapid permeability or moderate permeability and excessive slope are the main limitations on sites for sanitary facilities. Excessive slope is the main limitation affecting recreational development.

5. Wainola-Deford Association

Deep, nearly level and gently sloping, somewhat poorly drained to very poorly drained, sandy and mucky soils in glacial lake basins

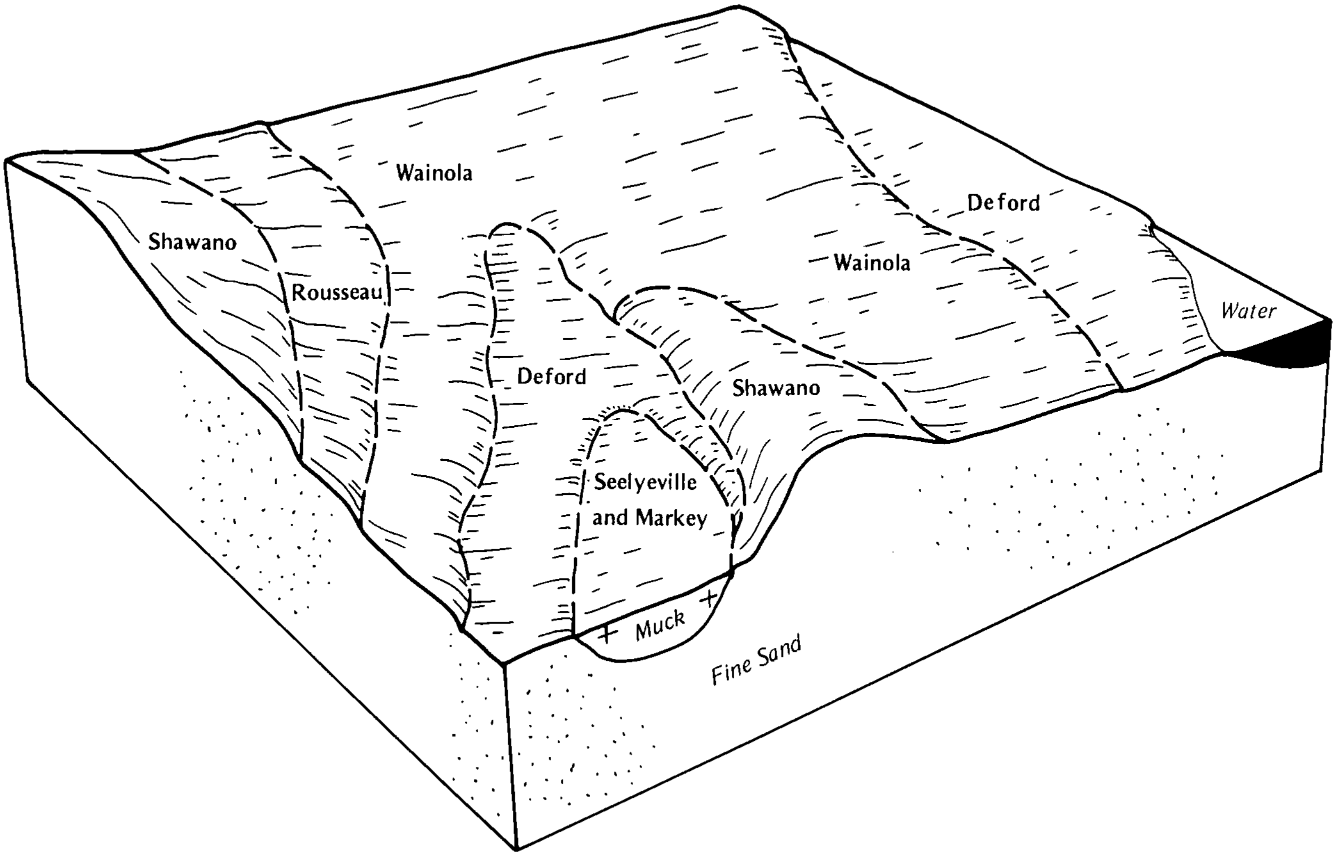

Figure 5.—Pattern of soils and parent material in the Wainola-Deford association.

Areas of these soils are on flats and in depressions and drainageways. Slopes range from 0 to 3 percent.

This association makes up about 8 percent of the county. It is about 35 percent Wainola or similar soils, 30 percent Deford soils, and 35 percent soils of minor extent (fig. 5).

Wainola soils are on large flats and in depressions and drainageways. They are somewhat poorly drained. Slope ranges from 0 to 3 percent. Permeability is rapid. The available water capacity is low. Typically, about half an inch of black, partially decomposed forest litter is on the surface. The surface layer is black, very friable loamy fine sand about 2 inches thick. The subsurface layer is brown, very friable fine sand about 3 inches thick. The subsoil is about 28 inches thick. It is brown, mottled, very friable loamy fine sand and fine sand. The substratum to a depth of about 60 inches is brown, mottled fine sand.

Deford soils are on flats and in depressions and drainageways. They are poorly drained and very poorly drained. Slope ranges from 0 to 2 percent. Permeability is rapid. The available water capacity is low. Typically, the surface layer is black, very friable mucky fine sand about 2 inches thick. The substratum to a depth of about 60 inches is fine sand. It is light brownish gray and mottled in the upper part, yellowish brown and mottled in the next part, and brown in the lower part.

Some of the soils of minor extent in this association are the Markey, Rousseau, Seelyeville, and Shawano soils. The very poorly drained, organic Markey and Seelyeville soils are in depressions and drainageways. The moderately well drained Rousseau soils are on the slightly higher flats and ridges. They formed in deposits similar to those of the Wainola soils. The excessively drained Shawano soils are on broad ridges and side slopes. They formed in sandy deposits.

Most areas of this association are used as woodland The main concerns in managing these soils for woodland are equipment limitations, which are caused by wetness; seedling mortality, caused by the droughtiness of the sandy subsoil or by wetness; and the windthrow hazard, caused by the seasonal high

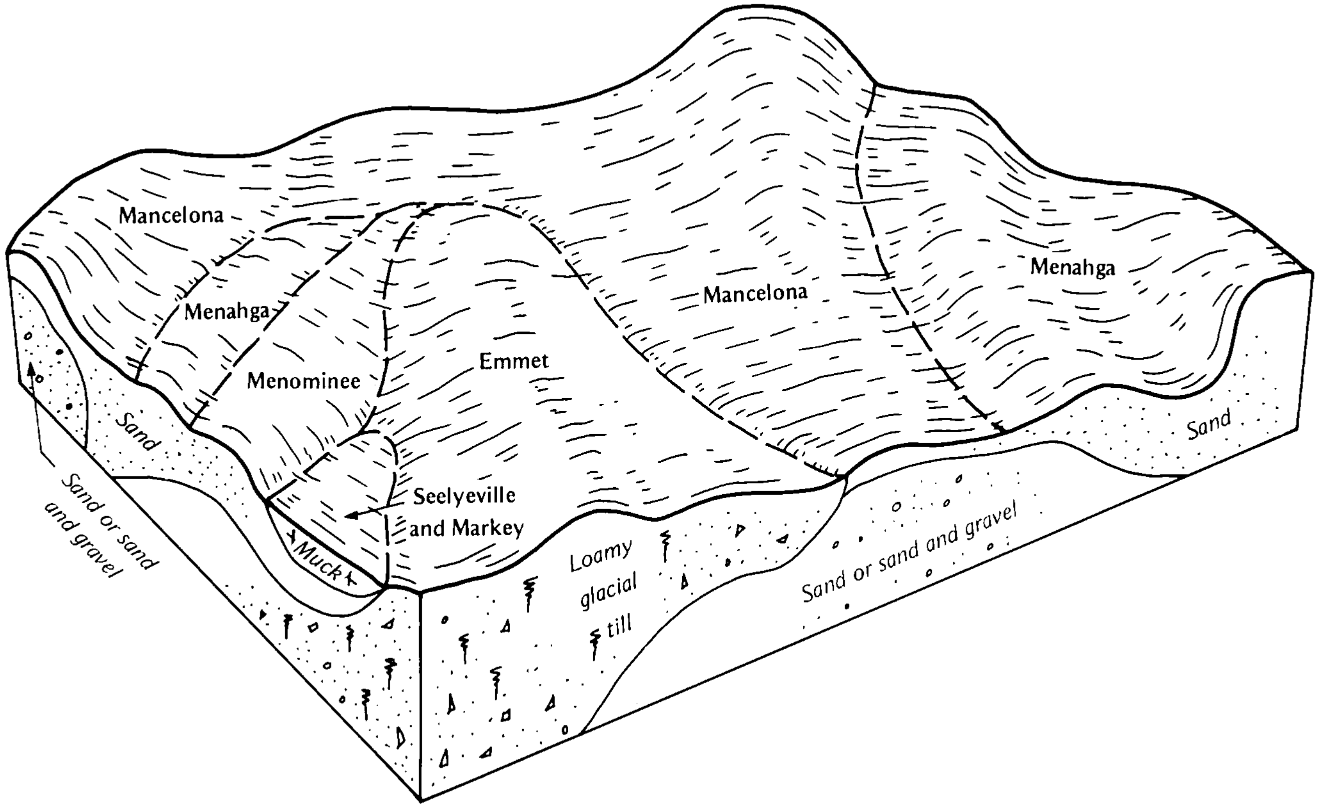

Figure 6.—Pattern of soils and parent material in the Mancelona-Emmet-Menahga association.

water table, which limits the rooting depth.

Some areas of the Wainola soils are used for crops or pasture. Drained areas are suited to crops and pasture. Wetness is the main management concern.

The major soils are poorly suited to dwellings and septic tank absorption fields.

6. Mancelona-Emmet-Menahga Association

Deep, nearly level to steep, well drained to excessively drained, sandy and loamy soils primarily on end moraines

Areas of these soils are on end moraines that range from broad, flat areas to irregularly shaped ridges. Slopes range from 0 to 30 percent.

This association makes up about 18 percent of the county. It is about 25 percent Mancelona and similar soils, 20 percent Emmet and similar soils, 20 percent Menahga soils, and 35 percent soils of minor extent (fig. 6).

Mancelona soils are on flats, ridgetops, and the side slopes of ridges. They are somewhat excessively drained. Slope ranges from 0 to 25 percent. Permeability is moderately rapid in the subsoil and very rapid in the substratum. The available water capacity is low. Typically, the surface layer is black, very friable loamy sand about 6 inches thick. The subsoil is about 33 inches thick. It is very friable. It is dark brown and dark reddish brown loamy sand in the upper part and dark yellowish brown sand in the lower part. The substratum to a depth of about 60 inches is pale brown gravelly sand.

Emmet soils are on broad ridgetops and the side slopes of ridges. They are well drained. Slope ranges from 1 to 30 percent. Permeability is moderate in the upper part of the soils and moderately rapid in the lower part. The available water capacity is moderate. Typically, the surface layer is very dark gray, very friable fine sandy loam about 3 inches thick. The subsurface layer is pinkish gray, very friable fine sandy loam about 1 inch thick. The upper part of the subsoil is brown, very friable fine sandy loam about 6 inches thick. The next 8 inches is light brownish gray and dark reddish brown, very friable and firm fine sandy loam.

The lower part of the subsoil is dark reddish brown and yellowish red, friable fine sandy loam about 15 inches thick. The substratum to a depth of about 60 inches is reddish brown fine sandy loam.

Menahga soils are on flats, broad ridges and knobs, and the side slopes of ridges. They are excessively drained. Slope ranges from 0 to 25 percent. Permeability is rapid. The available water capacity is low. Typically, the surface layer is black, very friable sand about 2 inches thick. The subsurface layer is dark grayish brown, very friable sand about 1 inch thick. The subsoil is sand about 22 inches thick. It is dark brown and very friable in the upper part and strong brown and loose in the lower part. The substratum to a depth of about 60 inches is yellowish brown and light yellowish brown sand.

Some of the soils of minor extent in this association are the Au Gres, Iosco, Markey, Menominee, Roscommon, and Seelyeville soils. The somewhat poorly drained Au Gres and Iosco soils are adjacent to or in depressions and drainageways. Au Gres soils are sandy throughout. Iosco soils formed in sandy deposits and in the underlying loamy deposits. The very poorly drained, organic Markey and Seelyeville soils are in depressions and drainageways. The well drained Menominee soils formed in sandy deposits and in the underlying loamy till on ridgetops and the side slopes of ridges. The poorly drained and very poorly drained Roscommon soils formed in mucky and sandy deposits in depressions and drainageways.

Most areas of this association are used as woodland. The main concerns in managing the Mancelona soils for woodland are the hazard of water erosion and the equipment limitations on the steeper slopes. The main concerns in managing the Emmet soils are equipment limitations, which are caused by low soil strength during wet periods and by the slope. The main concerns in managing the Menahga soils are equipment limitations, which are caused by the sandy layers and the slope, and the hazard of water erosion on the steeper slopes. Seedling mortality, which is caused by droughtiness, is also a concern on the Menahga soils.

Some areas of this association are used for crops or pasture. The less sloping areas of the Emmet soils are suited to crops and pasture. Controlling water erosion and maintaining fertility are the main concerns in managing these soils. The less sloping areas of the Mancelona and Menahga soils are suited to some crops if these areas are irrigated and protected from soil blowing. Droughtiness and soil blowing are the main concerns in managing these soils.

The less sloping areas of the major soils are suited to dwellings. The Mancelona and Menahga soils are poorly suited to septic tank absorption fields because of the poor filtering capacity and the danger of ground-water pollution. The less sloping Emmet soils are only moderately suited to septic tank absorption fields because of moderate permeability.

7. Menahga Association

Deep, nearly level to steep, excessively drained, sandy soils on moraines, outwash plains, and stream terraces

Areas of these soils are on moraines, outwash plains, and stream terraces. The moraines are generally long and narrow and oriented from northeast to southwest. The outwash plains are generally broad and long. The stream terraces parallel moraines and major rivers. Slopes range from 0 to 25 percent.

This association makes up about 25 percent of the county. It is about 65 percent Menahga soils and 35 percent soils of minor extent (fig. 7).

Menahga soils are on flats, broad ridges, and the side slopes of knobs and ridges. They are excessively drained. Slope ranges from 0 to 25 percent. Permeability is rapid. The available water capacity is low. Typically, the surface layer is black, very friable sand about 2 inches thick. The subsurface layer is dark grayish brown, very friable sand about 1 inch thick. The subsoil is sand about 22 inches thick. It is dark brown and very friable in the upper part and strong brown and loose in the lower part. The substratum to a depth of about 60 inches is yellowish brown and light yellowish brown sand.

Some of the soils of minor extent in this association are the Au Gres, Croswell, Dawson, Ishpeming, Loxley, Markey, Pence, Roscommon, Sayner, and Seelyeville soils. Also of minor extent are areas of Rock outcrop. The somewhat poorly drained Au Gres, moderately well drained Croswell, and poorly drained and very poorly drained Roscommon soils are sandy throughout. Au Gres and Roscommon soils are adjacent to or in depressions and drainageways. Croswell soils are on flats, ridges, and side slopes. The very poorly drained, organic Dawson, Loxley, Markey, and Seelyeville soils are in depressions and drainageways. The somewhat excessively drained Ishpeming soils formed in sandy deposits underlain by igneous or metamorphic bedrock. They are on ridges and the side slopes of ridges. The well drained Pence soils formed in loamy and sandy deposits on flats and on broad ridgetops and the side slopes of ridges. The excessively drained Sayner soils formed in sandy deposits and in the underlying gravelly sand or stratified sand and gravel on ridges and the

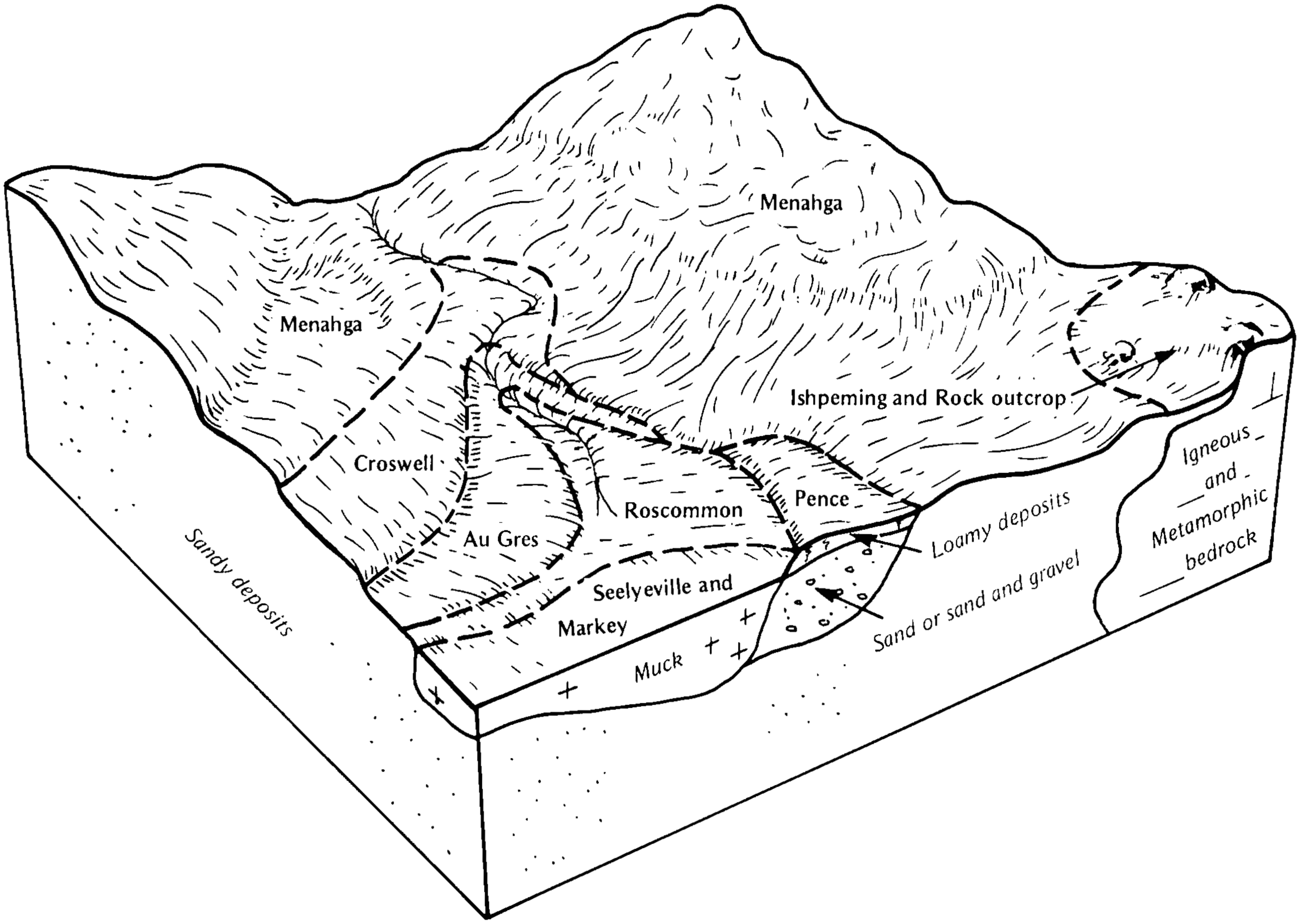

Figure 7.—Pattern of soils and parent material in the Menahga association.

side slopes of ridges. Rock outcrop is exposed granite or metamorphic bedrock.

Most areas of this association are used as woodland. The main concerns in managing this soil for woodland are equipment limitations, which are caused by the sandy layers and the slope, and the hazard of water erosion on the steeper slopes. Seedling mortality, which is caused by droughtiness, is also a management concern.

Some areas of this association are used for crops. The less sloping areas are suited to some crops if these areas are irrigated and protected from soil blowing. Droughtiness and soil blowing are the main concerns in managing these soils.

The less sloping areas of the Menahga soils are suited to dwellings. They are poorly suited to septic tank absorption fields because of the poor filtering capacity and the danger of ground-water pollution.

8. Pence-Padus Association

Deep, nearly level to very steep, well drained, loamy soils on outwash plains, stream terraces, moraines, kames, and eskers

Areas of these soils are on outwash plains, stream terraces, moraines, kames, and eskers. The landform ranges from broad, convex plains to irregularly shaped ridges. Slopes range from 1 to 35 percent.

This association makes up about 10 percent of the county. It is about 40 percent Pence and similar soils, 25 percent Padus soils, and 35 percent soils of minor extent.

Pence soils are on flats, broad ridgetops, and the side slopes of ridges. They are well drained. Slope

ranges from 1 to 35 percent. Permeability is moderately rapid in the loamy upper part of the profile and rapid or very rapid in the substratum. The available water capacity is low. Typically, the surface layer is black, very friable sandy loam about 1 inch thick. The subsurface layer is dark brown, very friable sandy loam about 1 inch thick. The subsoil is about 19 inches thick. It is very friable. It is dark reddish brown and reddish brown sandy loam in the upper part and strong brown gravelly sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown gravelly sand.

Padus soils are on flats, ridgetops, and the side slopes of ridges. They are well drained. Slope ranges from 1 to 25 percent. Permeability is moderate or moderately rapid in the loamy upper part of the profile and rapid or very rapid in the sandy and gravelly lower part of the subsoil and in the substratum. The available water capacity is moderate. Typically, the surface layer is black, very friable fine sandy loam about 1 inch thick. The subsurface layer is brown, very friable fine sandy loam about 4 inches thick. The subsoil is very friable. The upper part is brown fine sandy loam about 8 inches thick. The next 7 inches is also brown fine sandy loam. The lower part of the subsoil is about 7 inches thick. It is reddish brown. It is sandy loam in the upper part and loamy sand in the lower part. The substratum extends to a depth of about 60 inches. It is strong brown sand in the upper part and reddish brown, stratified sand and gravelly sand in the lower part.

Some of the soils of minor extent in this association are the Au Gres, Croswell, Keweenaw, Markey, Menahga, Roscommon, and Seelyeville soils. The somewhat poorly drained Au Gres and moderately well drained Croswell soils are sandy throughout. Au Gres soils are adjacent to or in depressions and drainageways. Croswell soils are on flats, ridges, and the side slopes of ridges. The well drained Keweenaw soils formed in sandy and loamy deposits on broad ridges and the side slopes of ridges. The very poorly drained, organic Markey and Seelyeville soils are in depressions and drainageways. The excessively drained Menahga soils are on flats, broad ridges, and the side slopes of ridges and knobs. They are sandy throughout. The poorly drained and very poorly drained Roscommon soils are in depressions and drainageways. They formed in mucky and sandy deposits.

Most areas of this association are used as woodland. The main concerns in managing the Pence soils for woodland are equipment limitations on the steeper slopes. The main concerns in managing the Padus soils are equipment limitations, which are caused by low soil strength during wet periods and by the slope.

The less sloping areas of the major soils are suited to dwellings. They are poorly suited to septic tank absorption fields because of the poor filtering capacity and the danger of ground-water pollution.

9. Ishpeming-Michigamme-Rock Outcrop Association

Moderately deep, gently sloping to moderately steep, somewhat excessively drained and well drained, sandy and loamy soils, and Rock outcrop, on outwash plains and moraines

Areas of these soils are on outwash plains and moraines. The outwash plains range from broad and flat to undulating. The moraines are irregularly shaped ridges. Slopes range from 4 to 15 percent.

This association makes up about 7 percent of the county. It is about 25 percent Ishpeming soils, 23 percent Michigamme soils, 20 percent Rock outcrop, and 32 percent soils of minor extent.

Ishpeming soils are on ridges and the side slopes of ridges. They are somewhat excessively drained. Slope ranges from 4 to 15 percent. Permeability is rapid. The available water capacity is low. Typically, the surface layer is very dark gray, very friable loamy fine sand about 3 inches thick. The subsurface layer is pinkish gray, very friable loamy fine sand about 3 inches thick. The subsoil is about 18 inches thick. It is very friable. It is dark reddish brown and reddish brown loamy fine sand in the upper part and reddish brown fine sand in the lower part. The substratum is brown fine sand about 12 inches thick. Granite bedrock is at a depth of about 36 inches.

Michigamme soils are on ridgetops and the side slopes of ridges. They are well drained. Slope ranges from 4 to 15 percent. Permeability is moderate. The available water capacity is low. Typically, the surface layer is black, very friable fine sandy loam about 2 inches thick. The subsurface layer is reddish gray, very friable fine sandy loam about 2 inches thick. The subsoil is very friable fine sandy loam about 20 inches thick. It is dark reddish brown in the upper part, reddish brown in the next part, and brown in the lower part. Granite bedrock is at a depth of about 24 inches.

The Rock outcrop is exposed igneous or metamorphic bedrock.

Some of the soils of minor extent in this association are the Au Gres, Charlevoix, Emmet, Ensley, Markey, Padus, Roscommon, and Seelyeville soils. The somewhat poorly drained Au Gres and poorly drained

and very poorly drained Roscommon soils formed in sandy deposits adjacent to or in depressions and drainageways. The somewhat poorly drained Charlevoix and poorly drained and very poorly drained Ensley soils formed in loamy deposits in depressions and drainageways. The well drained Emmet soils formed in loamy deposits on broad ridgetops and the side slopes of ridges. The well drained Padus soils formed in loamy and sandy deposits underlain by stratified sand or sand and gravel. They are on flats, ridgetops, and the side slopes of ridges. The very poorly drained, organic Markey and Seelyeville soils are in depressions and drainageways.

Most areas of this association are used as woodland. The Ishpeming soils have no management concerns. The use of equipment is limited because of low soil strength in the Michigamme soils during wet periods and because of numerous bedrock outcrops.

The major soils are poorly suited to dwellings with basements and to septic tank absorption fields, mainly because of the shallowness to bedrock.

Areas Dominated by Organic Soils

This group of associations makes up about 9 percent of the county. The soils are nearly level to steep. They formed in glacial lake basins and on outwash plains, stream terraces, moraines, and drumlins. They are dominantly very poorly drained, but some are well drained.

Most areas of this group are used as woodland. Some areas are used as wildlife habitat. Wetness and low soil strength are the main limitations in managing these soils as woodland, cropland, or pasture or for building site development, sanitary facilities, or recreational development.

10. Seelyeville-Markey-Emmet Association

Deep, nearly level to steep, very poorly drained and well drained, mucky and loamy soils in glacial lake basins, on stream terraces, outwash plains, and moraines, or on upland moraines and drumlins

Areas of these soils are on low drumlins and ground moraines and in depressions and drainageways. The drumlins are oriented from northeast to southwest. The moraines are irregularly shaped ridges. The drainageways and depressions lie between the drumlins and moraines or completely surround them. Slopes range from 0 to 30 percent.

This association makes up about 6 percent of the county. It is about 30 percent Seelyeville soils, 20 percent Markey soils, 20 percent Emmet soils, and 30 percent soils of minor extent.

Seelyeville soils are in depressions and drainageways. They are very poorly drained. Slope is 0 to 1 percent. Permeability is moderately slow to moderately rapid. The available water capacity is very high. Typically, the upper 30 inches is very dark brown muck. The lower layer to a depth of about 60 inches is black muck.

Markey soils are in depressions and drainageways. They are very poorly drained. Slope is 0 to 1 percent. Permeability is moderately slow to moderately rapid in the organic material and rapid in the underlying sandy deposits. The available water capacity is very high. Typically, the upper 21 inches is black and very dark brown muck. The substratum to a depth of about 60 inches is fine sand. It is very dark gray in the upper part and grayish brown and mottled in the lower part.

Emmet soils are on broad ridgetops and the side slopes of ridges. They are well drained. Slope ranges from 1 to 30 percent. Permeability is moderate in the upper part of the soils and moderate or moderately rapid in the lower part. The available water capacity is moderate. Typically, the surface layer is very dark gray, very friable fine sandy loam about 3 inches thick. The subsurface layer is pinkish gray, very friable fine sandy loam about 1 inch thick. The upper part of the subsoil is brown, very friable fine sandy loam about 6 inches thick. The next 8 inches is light brownish gray and dark reddish brown, very friable and firm fine sandy loam. The lower part of the subsoil is dark reddish brown and yellowish red, friable fine sandy loam about 15 inches thick. The substratum to a depth of about 60 inches is reddish brown fine sandy loam.

Some of the soils of minor extent in this association are the Charlevoix, Iosco, Menominee, and Nadeau soils. The somewhat poorly drained Charlevoix soils formed in loamy deposits in depressions and drainageways. The somewhat poorly drained Iosco and well drained Menominee soils formed in sandy deposits and in the underlying loamy deposits. Iosco soils are in depressions and drainageways. Menominee soils are on ridges and the side slopes of ridges. The well drained Nadeau soils are on ridgetops and the side slopes of ridges. They formed in loamy deposits underlain by sandy and gravelly deposits.

Most areas of this association are used as woodland. The main concerns in managing the Markey and Seelyeville soils for woodland are equipment limitations, caused by wetness and low soil strength, and seedling mortality and the hazard of windthrow, caused by the

wetness. The main concerns in managing the Emmet soils are equipment limitations, which are caused by low soil strength during wet periods and by the slope.

Some areas of the Emmet soils are used for crops or pasture. The less sloping areas of the these soils are suited to these uses. The main management concerns are controlling water erosion and maintaining fertility.

The Markey and Seelyeville soils are generally unsuitable as sites for dwellings and septic tank absorption fields, primarily because of ponding and subsidence. The less sloping areas of the Emmet soils are suited to dwellings. They are only moderately suited to septic tank absorption fields because of moderate permeability.

11. Seelyeville-Markey Association

Deep, nearly level, very poorly drained, mucky soils in glacial lake basins and on stream terraces, outwash plains, and moraines

Areas of these soils are in depressions and drainageways on glacial lake basins, stream terraces, outwash plains, and moraines. Slope is 0 to 1 percent.

This association makes up about 3 percent of the county. It is about 45 percent Seelyeville soils, 40 percent Markey soils, and 15 percent soils of minor extent.

Seelyeville soils are commonly in the center of wetland areas where the organic material is thickest. They are very poorly drained. Slope is 0 to 1 percent. Permeability is moderately slow to moderately rapid. The available water capacity is very high. Typically, the upper layer is very dark brown muck about 30 inches thick. The lower layer to a depth of about 60 inches is black muck.

Markey soils are commonly around the edges of wetlands, adjacent to mineral soils. They are very poorly drained. Slope is 0 to 1 percent. Permeability is moderately slow to moderately rapid in the organic material and rapid in the underlying sandy deposits. The available water capacity is very high. Typically, the upper layer is black and very dark brown muck about 21 inches thick. The substratum to a depth of about 60 inches is fine sand. It is very dark gray in the upper part and grayish brown and mottled in the lower part.

Some of the soils of minor extent in this association are the Au Gres, Croswell, Dawson, Loxley, Menahga, and Roscommon soils. The somewhat poorly drained Au Gres and poorly drained and very poorly drained Roscommon soils formed in sandy deposits adjacent to or in depressions and drainageways. The moderately well drained Croswell soils formed in sandy deposits on flats, ridges, and the side slopes of ridges. The excessively drained Menahga soils formed in sandy deposits on flats, broad ridges, and the side slopes of ridges. The very poorly drained, organic Dawson and Loxley soils are in depressions and drainageways.

Most areas of this association are used as woodland. The main concerns in managing these soils are equipment limitations, which are caused by wetness and low soil strength, and seedling mortality and the hazard of windthrow, which are caused by wetness.

The major soils are generally unsuitable as sites for dwellings and septic tank absorption fields, primarily because of ponding and subsidence.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Emmet fine sandy loam, 1 to 6 percent slopes, is a phase of the Emmet series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Charlevoix-Emmet fine sandy loams, 1 to 6 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Seelyeville and Markey mucks, 0 to 1 percent slopes, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

The detailed soil map units in Marinette County join with similar map units that may have different names in adjacent counties. These differences occur because of changes in the classification of two series and because laboratory data indicate that the soils that formed in glacial till in Marinette County average slightly less clay in the subsoil than do similar soils in different counties. Soils that have a higher clay content are unnamed similar inclusions in the map units in Marinette County. Other differences result partly from variations in the extent and pattern of the soils in the different counties. None of the differences significantly affects the use of the detailed soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

AdA—Allendale loamy sand, 0 to 3 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is in depressions and drainageways in glacial lake basins and on outwash plains. Individual areas are oblong or irregular in shape and generally range from 5 to 120 acres in size.

Typically, the surface layer is very dark gray, very friable loamy sand about 3 inches thick. The subsurface layer is brown, very friable loamy sand about 2 inches thick. The subsoil is 14 inches of reddish brown, mottled, very friable loamy sand and yellowish red, mottled, very friable sand. The next 8 inches is reddish brown, mottled, very friable loamy sand. Below this is 4 inches of reddish brown, mottled, friable silty clay. The substratum to a depth of about 60 inches is reddish brown, mottled silty clay. In places the surface layer is sand.

Included with this soil in mapping are small areas of Au Gres, Manistee, and Pinconning soils. Au Gres soils are sandy throughout. They are in landscape positions similar to those of the Allendale soil. Manistee soils are well drained and are on the slightly higher ridges. Pinconning soils are poorly drained and very poorly drained and are in the lower depressions and drainageways. Included soils make up 1 to 15 percent of the unit.

Permeability is rapid in the sandy upper part of the profile in the Allendale soil and slow in the lower clayey deposits. The available water capacity is low. Unless the soil is drained, the root development for most crops is restricted by a seasonal high water table at a depth of 1 to 2 feet.

Most areas of this soil are used as woodland. Some are drained and used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations and the windthrow hazard. The use of equipment is restricted in spring and in other excessively wet periods by the seasonal high water table. The soil is easily rutted by wheeled vehicles during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. A shallow rooting depth, which is caused by the high water table, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control plant competition.

If drained, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. Open ditches and tile drains can improve internal drainage. If the water table is excessively lowered, however, crop yields are limited by the low available water capacity in most years. Ditchbanks are easily eroded unless they are protected by a vegetative cover. Areas that are drained and cultivated are subject to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to control soil blowing and conserve moisture.

If drained, this soil is suited to pasture and hay. Overgrazing depletes the plant cover and results in soil blowing. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields because of the wetness and the rapid permeability in the sandy upper part of the profile and the slow permeability in the clayey lower part. Overcoming these limitations is difficult. A better suited site should be considered. The soil is poorly suited to dwellings because of the wetness. Constructing dwellings without basements or building on fill material helps to overcome this limitation. The soil is only moderately suited to local roads and streets because of the wetness and a moderate potential for frost action. These limitations can be overcome by adding suitable fill material, such as sand or gravel, which can raise the roadbed above the level of wetness. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is IIIw. The woodland ordination symbol is 4W. The habitat type is TMC.

AkC—Alpena gravelly sandy loam, 6 to 12 percent slopes. This deep, sloping, excessively drained soil is on ridgetops and the sides of ridges on outwash plains, eskers, and kames. Individual areas are oblong and generally range from 3 to 50 acres in size.

Typically, the surface layer is very dark grayish brown, very friable gravelly sandy loam about 3 inches thick. The subsoil is about 6 inches thick. It is brown, very friable gravelly loamy sand in the upper part and brown very gravelly sand in the lower part. The substratum to a depth of about 60 inches is yellowish

brown, stratified sand and very gravelly sand. In places the slope is as little as 3 percent or as much as 15 percent.

Included with this soil in mapping are small areas of Mancelona, Menahga, Nadeau, and Shawano soils. These soils are in landscape positions similar to those of the Alpena soil. The somewhat excessively drained Mancelona soils have less gravel in the solum than the Alpena soil. Also, they are deeper to the sandy and gravelly substratum. The well drained Nadeau soils have more clay and less gravel in the upper part of the solum than the Alpena soil. Also, they are deeper to the sandy and gravelly deposits. The excessively drained Menahga and Shawano soils are sandy throughout. Included soils make up 5 to 15 percent of the unit.

Permeability is very rapid in the Alpena soil. The available water capacity is very low. The root development for most crops is limited by the droughtiness of the very gravelly sand below a depth of about 7 inches.

Most areas of this soil are used as woodland. Some have been cleared and are used as unimproved pasture. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The main concern in managing woodland is the seedling mortality resulting from droughtiness. Planting when the soil is moist can reduce seedling losses. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel.

This soil is generally unsuited to cultivated crops and pasture because of the very low available water capacity and a moderate or severe hazard of water erosion. Gravel generally interferes with cultivation.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. The soil is only moderately suited to dwellings and to local roads and streets because of the slope. This limitation can be overcome by cutting and filling or by constructing roads on the contour. Also, the less sloping areas can be selected as building sites.

The land capability classification is VIs. The woodland ordination symbol is 3S. The habitat type is PMV.

AkE—Alpena gravelly sandy loam, 12 to 35 percent slopes. This deep, moderately steep to very steep, excessively drained soil is on the side slopes of ridges on outwash plains, eskers, and kames. Individual areas are long and narrow and generally range from 3 to 320 acres in size.

Typically, the surface layer is black, very friable gravelly sandy loam about 3 inches thick. The subsoil is brown, very friable gravelly sandy loam about 5 inches thick. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and very gravelly sand. In some places the surface layer is gravelly loamy sand. In other places the slope is as little as 8 percent.

Included with this soil in mapping are small areas of Mancelona, Menahga, and Shawano soils. These soils are in landscape positions similar to those of the Alpena soil. The somewhat excessively drained Mancelona soils have less gravel in the solum than the Alpena soil. Also, they are deeper to the sandy and gravelly substratum. The excessively drained Menahga and Shawano soils are sandy throughout. Included soils make up 10 to 15 percent of the unit.

Permeability is very rapid in the Alpena soil. The available water capacity is very low.

Most areas of this soil are used as woodland. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The main concerns in managing woodland are the hazard of water erosion, equipment limitations, and the seedling mortality resulting from droughtiness. The erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing the water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads on the contour help to control erosion. Seeding exposed areas after logging helps to establish a protective vegetative cover. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary. The slope limits the selection of sites for logging roads and landings. Logging roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils. Planting when the soil is moist can reduce seedling losses. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate.

This soil is generally unsuited to cultivated crops and pasture because of the very low available water capacity and a very severe hazard of water erosion. The soil is generally unsuited to septic tank

absorption fields and to dwellings because of the slope. This limitation is difficult to overcome. A more suitable site should be selected. If this soil is used as a site for septic tank absorption fields, the poor filtering capacity can result in the pollution of ground water. The soil is poorly suited to local roads and streets because of the slope. Cutting and filling or constructing the roads and streets on the contour helps to overcome this limitation.

The land capability classification is VIIs. The woodland ordination symbol is 3R. The habitat type is PMV.

Ar—Arnheim silt loam, 0 to 1 percent slopes. This deep, nearly level, poorly drained soil is in depressions and low areas on flood plains. It is subject to frequent flooding. Many areas are dissected by old river channels. Individual areas are elongated or ribbonlike in shape and generally range from 5 to 240 acres in size.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 3 inches thick. The upper part of the substratum is dark grayish brown, grayish brown, and reddish brown, mottled silt loam. The next part is brown and reddish brown loamy fine sand. The lower part to a depth of about 60 inches is yellowish brown, mottled sand.

Included with this soil in mapping are small areas of Brevort, Bruce, Deford, Markey, and Roscommon soils in depressions and drainageways. Brevort soils are sandy in the upper 20 to 40 inches. Bruce soils have more clay in the subsoil than the Arnheim soil. Deford and Roscommon soils are sandy throughout. Markey soils are muck to a depth of 16 to 51 inches. Also included are some soils that have many cobbles in the surface layer or that are covered with water behind beaver dams. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Arnheim soil. The available water capacity is low. Unless the soil is drained, root development is restricted by a seasonal high water table between the surface and a depth of 1 foot.

Most areas of this soil are used as woodland. Some have been cleared and are used as unimproved pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The soil is usually wet most of the year, is subject to frequent flooding, and has low strength. Ruts form easily when wheeled skidders are used during the wet periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. All-weather roads require a gravel base. Culverts are needed to maintain the natural drainage system. Wetness and low strength are severe limitations on landing sites. The better suited adjacent soils may be needed as sites for landings. Trees generally are not planted on this soil because of the excessive wetness. Reforestation is limited to natural regeneration or hand planting. Seedling mortality, which is caused by wetness and flooding, can be minimized by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

This soil is generally unsuitable for cultivated crops because of the high water table and the frequent flooding. Most areas cannot be drained. Because of the high water table and the frequent flooding, the soil is unsuitable for most forage species. It can be used for such species as reed canarygrass.

This soil is generally unsuited to septic tank absorption fields, dwellings, and local roads and streets, mainly because of the frequent flooding and the high water table. Overcoming these limitations is difficult. A better suited site should be considered.

The land capability classification is Vw. The woodland ordination symbol is 5W. A habitat type has not been assigned.

AuA—Au Gres loamy sand, 0 to 3 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is adjacent to or in depressions and drainageways on outwash plains. Individual areas are irregular in shape and generally range from 3 to 300 acres in size.

Typically, the surface layer is black, very friable loamy sand about 3 inches thick. The subsurface layer is light brownish gray, mottled, very friable sand about 4 inches thick. The subsoil is mottled, very friable sand about 22 inches thick. It is dark reddish brown and reddish brown in the upper part and strong brown in the lower part. The substratum to a depth of about 60

inches is strong brown, mottled sand. In some places the surface layer is loamy fine sand. In other places the slope is as much as 5 percent.

Included with this soil in mapping are small areas of Croswell, Menahga, and Roscommon soils. The moderately well drained Croswell soils and the excessively drained Menahga soils are slightly higher on the landscape than the Au Gres soil. The poorly drained and very poorly drained Roscommon soils are in the slightly lower positions on the landscape. Included soils make up 0 to 15 percent of the unit.

Permeability is rapid in the Au Gres soil. The available water capacity is low. Unless the soil is drained, root development is restricted by a seasonal high water table at a depth of 6 inches to 1.5 feet.

Most areas of this soil are used as woodland. Some are drained and used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The use of equipment is restricted in spring and in other excessively wet periods by the seasonal high water table. The soil is easily rutted by wheeled vehicles during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. Seedling mortality is caused by droughtiness. Planting when the soil is moist can reduce seedling losses. A shallow rooting depth, which is caused by the high water table, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control plant competition. Subsequent invading species should be controlled.

If drained, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. Surface drains remove excess surface water rapidly. Open ditches and tile drains can improve subsurface drainage. If the water table is excessively lowered, however, crop yields are limited by the low available water capacity in most years. Where tile drains are installed, loose sand can enter the tile lines unless a suitable filter is used. Unless protected by a plant cover, ditchbanks are easily eroded by flowing water. Vertical banks can cave in and plug the ditch. Areas that are drained and cultivated are subject to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss. The soil is suited to sprinkler irrigation. Because of the rapid permeability, the irrigation rate should be limited. If the rate is excessive, plant nutrients can be leached from the root zone.

Unless drained, this soil is unsuitable for most forage species. If drained, however, it is suited to pasture and hay. Forage yields are restricted unless fertilizer and irrigation water are applied. Overgrazing depletes the plant cover and results in soil blowing. Drainage systems, proper stocking rates, pasture rotation, and timely deferment of grazing are needed to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields because of the seasonal high water table and the rapid permeability. Overcoming these limitations is difficult. A better suited site should be considered.

This soil is poorly suited to dwellings because of the seasonal high water table. Constructing dwellings without basements or building on fill material helps to overcome this limitation. The wetness also can be overcome by installing tile drains around the foundations and providing a gravity outlet or another dependable outlet. The soil is poorly suited to local roads and streets because of the wetness. This limitation can be overcome by adding suitable fill material, such as sand or gravel, which can raise the roadbed above the level of wetness. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is IVw. The woodland ordination symbol is 6W. The habitat type is TMC.

BaA—Banat sandy loam, 0 to 3 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is in depressions and drainageways on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 3 to 40 acres in size.

Typically, the surface layer is black, very friable sandy loam about 9 inches thick. The subsurface layer is brown, mottled, very friable sandy loam about 4 inches thick. The subsoil is about 14 inches thick. It is strong brown, mottled, friable gravelly sandy loam in the upper part; brown, mottled, very friable very gravelly sandy loam in the next part; and yellowish brown, mottled, very friable very gravelly loamy sand in the

lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled very gravelly sand. In some places the substratum is gravelly sand, coarse sand, or sand. In other places the surface layer is loam or fine sandy loam.

Included with this soil in mapping are small areas of Forada, Mancelona, and Nadeau soils. Forada soils are poorly drained and very poorly drained and are in the lower areas. They have less gravel in the subsoil and substratum than the Banat soil. Mancelona soils are somewhat excessively drained and are typically sandy throughout. They have less gravel than the Banat soil. They are on the slightly higher ridges. The well drained Nadeau soils have less gravel in the solum than the Banat soil and more clay in the lower part of the subsoil. They are on the slightly higher ridges. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the loamy upper part of the subsoil in the Banat soil and very rapid in the substratum. Surface runoff is slow. The available water capacity is low. Unless this soil is drained, the root development for most crops is restricted by a seasonal high water table at a depth of 6 inches to 1.5 feet.

Undrained areas of this soil are used as woodland. Some are cleared and used as unimproved pasture. Drained areas are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The use of equipment is restricted in spring, in late fall, and in other excessively wet periods by the seasonal high water table and by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for year-round roads, a gravel base is needed. Culverts are needed to maintain the natural drainage system. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment. Also, they can be established on the better suited adjacent soils. Seedling mortality is caused by droughtiness. Planting when the soil is moist can reduce seedling losses. A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

If drained, this soil is suited to corn and small grain and to legumes and grasses for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains can improve internal drainage, but installing the tile in the very gravelly subsoil and substratum may be difficult. If the water table is excessively lowered, crop yields are limited by the low available water capacity in most years. Ditchbanks are easily eroded unless they are protected by a vegetative cover. Proper management of crop residue and additions of other organic material improve tilth and fertility and increase the organic matter content and the rate of water infiltration.

If drained, this soil is suited to pasture and hay. Overgrazing depletes the plant cover and increases the extent of undesirable plant species. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and reduces the rate of water infiltration. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields because of the seasonal high water table and the rapid permeability. Overcoming these limitations is difficult. A better suited site should be considered. The soil is poorly suited to dwellings because of the seasonal high water table. Constructing dwellings without basements or building on fill material helps to overcome this limitation. The wetness also can be overcome by installing tile drains around the foundations and providing a gravity outlet or another dependable outlet. The soil is poorly suited to local roads and streets because of the wetness and a high potential for frost action. These limitations can be overcome by adding suitable fill material, such as sand or gravel, which can raise the roadbed above the level of wetness. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is IIIw. The woodland ordination symbol is 2W. The primary habitat type is TMC, and the secondary habitat type is ATM.

BnA—Bonduel loam, 0 to 3 percent slopes. This moderately deep, nearly level and gently sloping, somewhat poorly drained soil is in depressions and drainageways on ground moraines. Individual areas are

irregular in shape and generally range from 3 to 40 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loam about 6 inches thick. The subsoil is mottled, very friable loam about 14 inches thick. It is brown in the upper part, reddish brown in the next part, and brown in the lower part. The substratum is light brown, mottled fine sandy loam about 8 inches thick. Dolomite bedrock is at a depth of about 28 inches. In places the surface layer is silt loam or fine sandy loam.

Included with this soil in mapping are small areas of Charlevoix and Cunard soils. The somewhat poorly drained Charlevoix soils are in landscape positions similar to those of the Bonduel soil. They do not have dolomite within a depth of 60 inches. The well drained Cunard soils are in the higher landscape positions. Also included are soils that have dolomite fragments throughout or in which dolomite is within a depth of 20 inches. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Bonduel soil. Surface runoff is slow. The available water capacity is low. Unless the soil is drained, the root development for most crops is restricted by a seasonal high water table at a depth of 1 to 3 feet.

Undrained areas of this soil are used as woodland. Some have been cleared and are used as unimproved pasture. Drained areas are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations and the windthrow hazard. The use of equipment is restricted in spring, in late fall, and in other excessively wet periods by the perched seasonal high water table and by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for year-round roads, a gravel base is needed. Culverts are needed to maintain the natural drainage system. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment. Also, they can be established on the better suited adjacent soils. A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

If drained, this soil is suited to corn and small grain and to legumes and grasses for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains are restricted by the depth to dolomite. If the water table is excessively lowered, crop yields are limited by the low available water capacity in most years. Proper management of crop residue and additions of other organic material improve tilth and fertility and increase the organic matter content and the rate of water infiltration.

If drained, this soil is suited to pasture and hay. Overgrazing depletes the plant cover and increases the extent of undesirable plant species. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and reduces the rate of water infiltration. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table, a thin layer of suitable soil material, and possible seepage. In areas where the seasonal high water table is deeper than 2 feet, mounding with suitable filtering material helps to overcome these limitations. The soil is poorly suited to dwellings without basements because of the seasonal high water table. This limitation can be overcome by adding fill material, which can raise the site to a level above the water table. The soil is poorly suited to dwellings with basements because of the seasonal high water table and the depth to bedrock. Building on fill material above the water table helps to overcome the wetness. Installing a drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or gravel, help to prevent the damage to local roads and streets caused by a high potential for frost action.

The land capability classification is IIw. The woodland ordination symbol is 4W. The habitat type is TMC.

Bs—Brevort muck, 0 to 2 percent slopes. This nearly level, poorly drained and very poorly drained soil is in depressions and drainageways on ground moraines and outwash plains. In most areas it is subject to ponding. Individual areas are irregular in shape and are generally less than 40 acres in size.

Typically, the surface layer is black muck about 7

inches thick and very dark gray, very friable loamy fine sand about 7 inches thick. The substratum extends to a depth of about 60 inches. It is dark gray and brown, mottled fine sand in the upper part and reddish gray and brown, mottled sandy loam in the lower part. In places the surface layer is sand or fine sand.

Included with this soil in mapping are small areas of Deford, Ensley, Iosco, Markey, and Roscommon soils. Deford, Ensley, Markey, and Roscommon soils are in landscape positions similar to those of the Brevort soil. Deford and Roscommon soils are sandy throughout. Ensley soils are loamy throughout. Markey soils are muck to a depth of 16 to 51 inches. The somewhat poorly drained Iosco soils are in the slightly higher landscape positions. Included soils make up 3 to 15 percent of the unit.

Permeability is rapid in the sandy upper part of the profile in the Brevort soil and moderate in the loamy lower part. The available water capacity is low. Unless the soil is drained, root development is restricted by a seasonal high water table at or above the surface or within a depth of 1 foot.

Most areas of this soil are used as woodland. Some have been cleared and are used for unimproved pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The soil is usually wet most of the year. Ruts form easily when wheeled skidders are used during the wet periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. All-weather roads require a gravel base. Culverts are needed to maintain the natural drainage system. Wetness and low strength are severe limitations on landing sites. The better suited adjacent soils may be needed as sites for landings. Trees generally are not planted on this soil because of the excessive wetness. Reforestation is limited to natural regeneration or hand planting. Seedling mortality, which is caused by wetness, can be minimized by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

Unless drained, this soil is unsuited to cultivated crops. If drained, however, it is suited to corn and small grain and to legumes and grasses for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains can improve internal drainage. If the water table is excessively lowered, however, crop yields are limited by the low available water capacity in most years. Where tile drains are installed in the sandy upper part of the soil, loose sand can enter the tile lines unless a suitable filter is used. Unless protected by a plant cover, ditchbanks are easily eroded by flowing water. Vertical banks can cave in and plug the ditch. Areas that are drained and cultivated are subject to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

Unless drained, this soil is unsuitable for most forage species. If drained, however, it is suited to pasture and hay. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year results in a poorer survival rate unless irrigation water is applied. Overgrazing depletes the plant cover and results in soil blowing. Drainage systems, proper stocking rates, pasture rotation, and timely deferment of grazing are needed to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields and to dwellings because of the ponding. Overcoming this hazard is difficult. A better suited site should be considered. The soil is poorly suited to local roads and streets because of the ponding. This hazard can be overcome by constructing the roads and streets on raised, well compacted fill material. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is Vw, undrained. The woodland ordination symbol is 4W. A habitat type has not been assigned.

Bv—Bruce fine sandy loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained and very poorly drained soil is in depressions and drainageways on ground moraines, on outwash plains, and in glacial lake basins. It is subject to ponding. Individual areas are irregular in shape and generally range from 5 to 40 acres in size.

Typically, the surface layer is very dark gray, very

friable fine sandy loam about 7 inches thick. The subsoil is about 15 inches thick. It is grayish brown, mottled, very friable fine sandy loam in the upper part and brown, mottled, friable silty clay loam in the lower part. The substratum extends to a depth of about 60 inches. It is reddish brown, mottled silty clay in the upper part and reddish brown, mottled, stratified silt and very fine sand in the lower part. In places the surface layer is silt loam or loam.

Included with this soil in mapping are small areas of Deford, Fence, Gaastra, and Markey soils. Deford and Markey soils are in landscape positions similar to those of the Bruce soil. Deford soils formed in fine sand. Markey soils are muck to a depth of 16 to 51 inches. The well drained Fence soils have more silt and less clay in the solum than the Bruce soil. They are on ridges. The somewhat poorly drained Gaastra soils are in the slightly higher landscape positions. Included soils make up 1 to 15 percent of the unit.

Permeability is moderately slow in the Bruce soil. The available water capacity is moderate. Unless the soil is drained, the root development for most crops is restricted by a seasonal high water table at or above the surface or within a depth of 1 foot.

Most areas of this soil are used as woodland. Some have been cleared and are used as unimproved pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The soil is usually wet most of the year. Ruts form easily when wheeled skidders are used during the wet periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. All-weather roads require a gravel base. Culverts are needed to maintain the natural drainage system. Wetness and low strength are severe limitations on landing sites. The better suited adjacent soils may be needed as sites for landings. Trees generally are not planted on this soil because of the excessive wetness. Reforestation is limited to natural regeneration or hand planting. Seedling mortality, which is caused by wetness, can be minimized by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Subsequent invading species should be controlled.

Unless drained, this soil is unsuited to cultivated crops. If drained, however, it is suited to corn and small grain and to legumes for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains can improve internal drainage, but some areas do not have suitable outlets. Diversions on the adjacent upland soils help to protect this soil against overflow. Proper management of crop residue and additions of other organic material improve tilth and fertility and increase the organic matter content and the rate of water infiltration.

If drained, this soil is suited to pasture and hay. Overgrazing depletes the plant cover and increases the extent of undesirable plant species. A drainage system, proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields and to dwellings because of the ponding and the moderately slow permeability. Overcoming these limitations is difficult. A better suited site should be considered. The soil is poorly suited to local roads and streets because of the ponding and a high potential for frost action. These limitations can be overcome by constructing the roads and streets on raised, well compacted fill material. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is Vw, undrained. The woodland ordination symbol is 7W. A habitat type has not been assigned.

ChA—Charlevoix fine sandy loam, 0 to 3 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is in depressions and drainageways on ground moraines. Individual areas are irregular in shape and generally range from 3 to 120 acres in size.

Typically, the surface layer is black, very friable fine sandy loam about 4 inches thick. The subsurface layer is light brownish gray, mottled, very friable fine sandy loam about 2 inches thick. The subsoil is about 4 inches of brown, mottled, very friable fine sandy loam. The next 6 inches is brown, mottled, friable fine sandy loam. Below this is 4 inches of brown, mottled, friable loam and 3 inches of reddish brown, mottled, very friable sandy loam. The substratum to a depth of about 60 inches is reddish brown, mottled sandy loam.

Included with this soil in mapping are small areas of Bonduel, Emmet, Ensley, and Iosco soils. Bonduel soils are underlain by dolomite at a depth of 20 to 40 inches. The well drained Emmet soils are on the slightly higher ridges. Ensley soils are poorly drained and very poorly drained. They are in the lower areas. Iosco soils are sandy in the upper 20 to 40 inches. They are in landscape positions similar to those of the Charlevoix soil. Included soils make up 2 to 12 percent of the unit.

Permeability is moderate or moderately rapid in the Charlevoix soil. Surface runoff is slow. The available water capacity is high. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content. Unless the soil is drained, the root development for most crops is restricted by a seasonal high water table at a depth of 1 to 2 feet.

Undrained areas of this soil are used as woodland. Some have been cleared and are used as unimproved pasture. Drained areas are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations and the windthrow hazard. The use of equipment is restricted in spring, in late fall, and in other excessively wet periods by the seasonal high water table and by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for year-round roads, a gravel base is needed. Culverts are needed to maintain the natural drainage system. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment. Also, they can be established on the better suited adjacent soils. A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

If drained, this soil is suited to corn and small grain and to legumes and grasses for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains can improve internal drainage. Ditchbanks are easily eroded unless they are protected by a vegetative cover. Proper management of crop residue and additions of other organic material improve tilth and fertility and increase the organic matter content and the rate of water infiltration.

If drained, this soil is suited to pasture and hay. Overgrazing depletes the plant cover and increases the extent of undesirable plant species. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and reduces the rate of water infiltration. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during the wet periods help to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields because of the seasonal high water table. Overcoming this limitation is difficult. A better suited site should be considered. The soil is poorly suited to dwellings because of the wetness. This limitation can be overcome by constructing dwellings without basements or by building on fill material. The wetness also can be overcome by installing tile drains around the foundations and providing gravity outlets or other dependable outlets. The soil is poorly suited to local roads and streets because of a high potential for frost action. Installing a drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or gravel, help to prevent the road damage caused by frost action.

The land capability classification is IIw. The woodland ordination symbol is 3W. The primary habitat type is AViO, and the secondary habitat type is TMC.

CmB—Charlevoix-Emmet fine sandy loams, 1 to 6 percent slopes. These are deep, nearly level and gently sloping soils. The Charlevoix soil is somewhat poorly drained. It is in depressions and drainageways on ground moraines. The Emmet soil is well drained. It is on ridges on moraines and drumlins. Individual areas are irregular in shape and generally range from 10 to 100 acres in size. They are 50 to 60 percent Charlevoix fine sandy loam and 25 to 45 percent Emmet fine sandy loam. The two soils occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the surface layer of the Charlevoix soil is very dark brown, very friable fine sandy loam about 7 inches thick. The subsurface layer is grayish brown, very friable fine sandy loam about 2 inches thick. The subsoil is about 15 inches thick. It is brown, mottled, friable sandy loam in the upper part; reddish brown, mottled, firm loam in the next part; and reddish brown,

friable sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled sandy loam.

Typically, the surface layer of the Emmet soil is very dark gray, very friable fine sandy loam about 2 inches thick. The subsurface layer is brown, very friable fine sandy loam about 1 inch thick. The subsoil is about 23 inches thick. It is brown, very friable and friable fine sandy loam in the upper part; reddish brown, friable loam in the next part; and reddish brown, very friable sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown sandy loam.

Included with these soils in mapping are small areas of Ensley and Iosco soils. Ensley soils are poorly drained and very poorly drained. They are in the lower areas. Iosco soils have a sandy mantle 20 to 40 inches thick. They are in landscape positions similar to those of the Charlevoix soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the Charlevoix soil. It is moderate in the upper part of the Emmet soil and moderate or moderately rapid in the lower part. The available water capacity is high in both soils. Surface runoff is slow in cultivated areas of the Charlevoix soil and slow or medium on the Emmet soil. Unless the Charlevoix soil is drained, the root development for most crops is restricted by a seasonal high water table at a depth of 1 to 2 feet.

Many areas of these soils are used as woodland. Some have been cleared and are used as unimproved pasture. Some areas, where the Charlevoix soil has been drained, are used as cropland or pasture.

These soils are suited to trees. The main concerns in managing woodland are equipment limitations on both soils and the windthrow hazard on the Charlevoix soil. The use of equipment is restricted in spring and in other excessively wet periods by the seasonal high water table in the Charlevoix soil and by low strength in both soils. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soils are frozen or the snow cover is thick. When the soils are wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for year-round roads, a gravel base is needed. Culverts are needed to maintain the natural drainage system of the Charlevoix soil. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment. Also, they can be established on the better suited adjacent soils. A shallow rooting depth, which is caused by the high water table in the Charlevoix soil, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled in areas of the Charlevoix soil.

If the Charlevoix soil is drained, this map unit is suited to corn and small grain and to legumes and grasses for hay and pasture. The seasonal high water table is the main concern on the Charlevoix soil, and the hazard of water erosion is the main concern on the Emmet soil. A surface drainage system can remove surface water rapidly. Open ditches and tile drains can improve internal drainage. Ditchbanks are easily eroded unless they are protected by a vegetative cover. Conservation tillage, a conservation cropping system, contour farming, contour stripcropping, diversions, and grassed waterways help to prevent excessive soil loss.

If the Charlevoix soil is drained, this map unit is suited to pasture and hay. Water erosion generally is not a problem on these soils when they are used for pasture or hay. Overgrazing depletes the plant cover and increases the extent of undesirable plant species. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and reduces the rate of water infiltration. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

The soils in this unit require onsite investigation for most engineering uses. Areas of the Emmet soil are suited to dwellings but are only moderately suited to septic tank absorption fields because of the moderate permeability. This limitation can be overcome by building a filtering mound of suitable material. The Charlevoix soil is poorly suited to dwellings because of the seasonal high water table. This limitation can be overcome by adding fill material, which can raise the site to a level above the water table. The Charlevoix soil is poorly suited to septic tank absorption fields because of the seasonal high water table. Overcoming this limitation is difficult. A better suited site should be considered. Both soils are either poorly suited or only moderately suited to local roads and streets because of a high or moderate potential for frost action. Installing a drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or

gravel, help to overcome this limitation.

The land capability classification is IIw. The woodland ordination symbol is 3W for the Charlevoix soil and 3L for the Emmet soil. The primary habitat type is AViO, and the secondary habitat type is TMC for the Charlevoix soil and ATD for the Emmet soil.

CtB—Croswell loamy sand, 1 to 6 percent slopes. This deep, nearly level and gently sloping, moderately well drained soil is on flats and on ridges and side slopes on outwash plains and in glacial lake basins. Individual areas are long and narrow or irregular in shape and generally range from 5 to 360 acres in size.

Typically, the surface layer is black, very friable, loamy sand about 1 inch thick. The subsurface layer is brown, very friable loamy sand about 2 inches thick. The subsoil is about 27 inches thick. It is dark reddish brown, very friable loamy sand in the upper part; reddish brown, very friable sand in the next part; and yellowish red, mottled, very friable sand in the lower part. The substratum to a depth of about 60 inches is reddish brown and brown, mottled sand. In some places the surface layer is sand or sandy loam. In other places the slope is as much as 8 percent.

Included with this soil in mapping are small areas of Au Gres, Menahga, and Wainola soils. The somewhat poorly drained Au Gres soils are in the slightly lower landscape positions. The excessively drained Menahga soils are in higher landscape positions than those of the Croswell soil. The somewhat poorly drained Wainola soils formed in deposits of sandy material, which is dominantly fine sand in size. They are in slightly lower landscape positions than those of the Croswell soil. Included soils make up 1 to 15 percent of the unit.

Permeability is rapid in the Croswell soil. The available water capacity is low. A seasonal high water table is at a depth of 2 to 4 feet.

Most areas of this soil are used as woodland. A few areas are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland.

This soil is suited to trees. The main concern in managing woodland is the seedling mortality resulting from droughtiness. Planting when the soil is moist can reduce seedling losses. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate.

After trees are cut, plant competition can prevent or delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture, but crop yields are limited by the low available water capacity. Applications of fertilizer and irrigation water improve productivity. The soil is suited to sprinkler irrigation. Because of the rapid permeability, the irrigation rate should be limited. Limiting the rate helps to prevent the leaching of plant nutrients from the root zone. Water erosion generally is not a problem, but the soil is subject to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling soil blowing. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless irrigation water is applied. Overgrazing depletes the plant cover and results in soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and the rapid permeability. Mounding with suitable filtering material helps to overcome these limitations. The soil is only moderately suited to dwellings without basements and is poorly suited to dwellings with basements because of the seasonal high water table. This limitation can be overcome by constructing the basements above the level of wetness or by installing tile drains around the foundations and providing gravity outlets or other dependable outlets. The soil is only moderately suited to local roads and streets because of the wetness. This limitation can be overcome by adding fill material, which can raise the roadbed above the level of wetness, and by installing a good surface and subsurface drainage system.

The land capability classification is IVs. The woodland ordination symbol is 5S. The primary habitat type is PMV, and the secondary habitat type is AQV.

CuB—Cunard loam, 1 to 6 percent slopes. This moderately deep, nearly level and gently sloping, well drained soil is on ridges and ground moraines. Individual areas are elongated or irregular in shape and generally range from 3 to 300 acres in size.

Typically, the surface layer is dark brown, very friable loam about 5 inches thick. The next 6 inches is brown and dark brown, very friable fine sandy loam. The

subsoil is about 13 inches thick. It is reddish brown, friable loam in the upper part and brown, friable sandy loam in the lower part. The substratum is brown gravelly sandy loam about 5 inches thick. Dolomite bedrock is at a depth of about 29 inches. In some places the surface layer is fine sandy loam. In other places the depth to dolomite is more than 40 inches. In some areas the slope is as much as 10 percent.

Included with this soil in mapping are small areas of Bonduel, Emmet, and Summerville soils. The somewhat poorly drained Bonduel soils are in depressions and drainageways. Emmet and Summerville soils are in landscape positions similar to those of the Cunard soil. Emmet soils do not have dolomite within a depth of 60 inches. Summerville soils have dolomite within a depth of 10 to 20 inches. Also included are areas of Cunard soils that have dolomite escarpments or dolomite cobbles exposed on the surface. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Cunard soil. Surface runoff is slow or medium in cultivated areas. The available water capacity is low. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content. The root development for most crops is restricted within a depth of 20 to 40 inches by the underlying dolomite.

Areas of this soil are used as woodland, cropland, or pasture.

This soil is suited to trees (fig. 8). The main concerns in managing woodland are equipment limitations and the windthrow hazard. The use of equipment is restricted in spring, in late fall, and in other excessively wet periods by the low strength and the relatively shallow depth to dolomite. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for year-round roads, a gravel base is needed. Culverts are needed to maintain the natural drainage system. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment. Also, they can be established on the better suited adjacent soils. A shallow rooting depth, which is caused by the underlying dolomite, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

Figure 8.—A stand of sugar maple in an area of Cunard loam, 1 to 6 percent slopes.

This soil is suited to corn and small grain and to legumes and grasses for hay and pasture. If the soil is cultivated, the hazard of water erosion is slight or

moderate. Conservation tillage, a conservation cropping system, contour farming, contour stripcropping, and grassed waterways help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, depletes the plant cover. Grazing when the surface layer is wet causes surface compaction and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the moderate depth to dolomite. Inadequately treated sewage effluent flowing through crevices in the dolomite can pollute nearby water supplies. Mounding with suitable filtering material helps to overcome this limitation. The soil is only moderately suited to dwellings without basements because of the moderate depth to dolomite. This limitation can be overcome by backfilling with coarse textured material, such as sand or gravel, which can result in a level base deep enough for footings. The soil is poorly suited to dwellings with basements because of the depth to dolomite. Dwellings can be constructed with partially exposed basements to avoid excavating the bedrock. The soil is only moderately suited to local roads and streets because of the depth to dolomite and a moderate hazard of frost action. These limitations can be overcome by replacing the upper part of the soil with suitable base material, such as sand or gravel, and avoiding excavation into the dolomite.

The land capability classification is IIe. The woodland ordination symbol is 3D. The habitat type is ATD.

De—Deford mucky fine sand, 0 to 2 percent slopes. This deep, nearly level, poorly drained and very poorly drained soil is in depressions and drainageways and on flats. It is on outwash plains, on moraines, and in glacial lake basins. It is subject to ponding. Individual areas are irregular in shape and generally range from 3 to 3,000 acres in size.

Typically, the surface layer is black, very friable mucky fine sand about 2 inches thick. The substratum to a depth of about 60 inches is fine sand. It is light brownish gray and mottled in the upper part, yellowish brown and mottled in the next part, and brown in the lower part. In places the surface layer is fine sand.

Included with this soil in mapping are small areas of Brevort, Markey, Roscommon, Seelyeville, and Wainola soils. Brevort, Markey, Roscommon, and Seelyeville soils are in landscape positions similar to those of the Deford soil. Brevort soils are underlain by loamy deposits at a depth of 20 to 40 inches. Markey soils are muck to a depth of 16 to 51 inches. Roscommon soils formed in deposits of sandy or coarse sandy material. Seelyeville soils are muck to a depth of more than 51 inches. The somewhat poorly drained Wainola soils are in the slightly higher landscape positions. Included soils make up 2 to 15 percent of the unit.

Permeability is rapid in the Deford soil. The available water capacity is low. Unless the soil is drained, root development is restricted by a seasonal high water table at or above the surface or within a depth of 1 foot.

Most areas of this soil are used as woodland. The soil is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The use of equipment is restricted in spring and in other excessively wet periods by the seasonal high water table. The soil is easily rutted by wheeled vehicles during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. Trees generally are not planted on this soil because of the wetness, severe seedling mortality, and plant competition. Reforestation is limited to natural regeneration or hand planting. Seedling mortality, which is caused by the wetness, can be minimized by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the high water table, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

Unless drained, this soil is unsuited to cultivated crops. If drained, this soil is suited to corn and small grain and to legumes and grasses for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains can improve internal drainage. If the water table is excessively lowered, however, crop yields are limited by the low available water capacity in most years. Where tile drains are installed, loose sand can enter the tile lines unless a suitable filter is used. Ditchbanks are easily eroded, and vertical banks can cave in and plug the ditch. Areas that are drained and cultivated are subject

to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

If drained, this soil is suited to pasture and hay. Forage yields are restricted unless fertilizer and irrigation water are applied. Overgrazing depletes the plant cover and results in soil blowing. Drainage systems, proper stocking rates, pasture rotation, and timely deferment of grazing are needed to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields because of the ponding and the rapid permeability. The soil is generally unsuited to dwellings because of the ponding. Overcoming these limitations is difficult. A better suited site should be selected. The soil is poorly suited to local roads and streets because of the ponding. This hazard can be overcome by constructing the roads and streets on raised, well compacted fill material. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is Vw, undrained. The woodland ordination symbol is 4W. A habitat type has not been assigned.

EaC—Emmert-Pence-Sarona complex, 6 to 15 percent slopes. These deep, sloping and moderately steep soils are on the side slopes of ridges, primarily on end moraines. The Emmert soil is somewhat excessively drained. The Pence and Sarona soils are well drained. Individual areas are irregular in shape and generally range from 10 to 500 acres in size. They are 20 to 45 percent Emmert gravelly sandy loam, 15 to 35 percent Pence sandy loam, and 15 to 20 percent Sarona fine sandy loam. The three soils occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the surface layer of the Emmert soil is very dark brown, very friable gravelly sandy loam about 2 inches thick. The subsoil is about 22 inches thick. It is brown, very friable gravelly loamy sand in the upper part and brown, loose gravelly sand in the lower part. The substratum to a depth of about 60 inches is strong brown very gravelly sand. In places the slope is less than 6 percent or more than 15 percent.

Typically, the surface layer of the Pence soil is very dark gray, very friable sandy loam about 4 inches thick. The subsoil is about 15 inches thick. It is brown, very friable sandy loam in the upper part and reddish brown, very friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is grayish brown gravelly sand. In some small areas the slope is less than 6 percent or more than 15 percent.

Typically, the surface layer of the Sarona soil is black, very friable fine sandy loam about 2 inches thick. The subsurface layer is light brownish gray, very friable fine sandy loam about 2 inches thick. The subsoil is about 27 inches thick. It is brown, very friable fine sandy loam in the upper part; reddish brown, friable sandy loam in the next part; and yellowish red, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish red sandy loam. In places the slope is less than 6 percent or more than 15 percent.

Included with these soils in mapping are small areas of Menahga and Padus soils. These included soils are in landscape positions similar to those of the Emmert, Pence, and Sarona soils. Menahga soils are excessively drained and are sandy throughout. Padus soils formed in a loamy mantle 20 to 35 inches thick underlain by stratified sand or sand and gravel. Also included are areas of Emmert, Pence, and Sarona soils that have boulders in the surface layer. Included soils make up 10 to 15 percent of the unit.

Permeability is very rapid in the Emmert soil. It is moderately rapid in the subsoil of the Pence soil and rapid or very rapid in the substratum. Permeability is moderate in the Sarona soil. The available water capacity is very low in the Emmert soil, low in the Pence soil, and moderate in the Sarona soil.

Most areas of these soils are used as woodland. The substratum of the Emmert and Pence soils is a probable source of sand and gravel.

These soils are suited to trees. The main concerns in managing woodland are equipment limitations in areas of the Sarona soil and seedling mortality in areas of the Emmert soil. The use of equipment is restricted in spring and in other excessively wet periods by low strength in the Sarona soil. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soils are dry or the snow cover is thick. Landings can be established in the nearly level or gently sloping included or adjacent soils. The seedling mortality rate can be reduced on the Emmert soil by planting when the soil is moist. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species in areas of the Sarona soil. Special harvest methods may be needed to control the competing

plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

These soils are poorly suited to corn and small grain because of the moderate hazard of water erosion and the very low available water capacity in the Emmert soil and the low available water capacity in the Pence soil. The soils are suited to grasses and legumes for hay and pasture. Crop yields are limited by the available water capacity in the Emmert and Pence soils. Some areas of these soils have surface boulders, which interfere with tillage unless they are removed. If cultivated crops are grown, water erosion and soil blowing are hazards. Conservation tillage, a conservation cropping system, winter cover crops, proper management of crop residue, contour stripcropping, field windbreaks, and grassed waterways help to prevent excessive soil loss.

These soils are suited to grasses and legumes for pasture and hay, but forage yields generally are low on the Emmert and Pence soils because of the very low or low available water capacity. Overgrazing depletes the plant cover and results in water erosion. Proper stocking rates, pasture renovation, rotation grazing, and timely deferment of grazing help to keep the pasture in good condition.

The Emmert and Pence soils readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. The Sarona soil is only moderately suited to septic tank absorption fields because of the moderate permeability and the slope. The limited permeability can be overcome by mounding the site with suitable filtering material. The slope can be overcome by cutting and filling or by installing a trench absorption system on the contour. Also, the absorption field can be installed in areas of the included soils where the slope is less than 6 percent. Because of the slope, these soils are only moderately suited to dwellings. This limitation can be overcome by cutting and filling. Also, the dwellings can be constructed in areas of the included soils where the slope is less than 6 percent. Large stones are also a problem if the Emmert soil is used as a site for dwellings. Stones that interfere with construction can be removed by mechanical means. The soils are only moderately suited to local roads and streets because of the slope and a moderate potential for frost action in the Sarona soil. The slope can be overcome by cutting and filling. Also, the road can be built in the less sloping areas. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action. The large stones in areas of the Emmert soil interfere with construction. They can be removed by mechanical means.

The land capability classification is IVs. The woodland ordination symbol is 6S for the Emmert soil, 3A for the Pence soil, and 3L for the Sarona soil. The primary habitat type is AQVib, and the secondary habitat type is ATM.

EaD—Emmert-Pence-Sarona complex, 15 to 35 percent slopes. These deep, moderately steep to very steep soils are on uneven side slopes of ridges, primarily on end moraines. The Emmert soil is somewhat excessively drained. The Pence and Sarona soils are well drained. Individual areas are irregular in shape and generally range from 10 to 750 acres in size. They are 15 to 35 percent Emmert gravelly sandy loam, 15 to 30 percent Pence sandy loam, and 15 to 30 percent Sarona fine sandy loam. The three soils occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the surface layer of the Emmert soil is very dark brown, very friable gravelly sandy loam about 2 inches thick. The subsoil is about 21 inches thick. It is brown, very friable gravelly loamy sand in the upper part and brown, loose very gravelly sand in the lower part. The substratum to a depth of about 60 inches is strong brown very gravelly sand. In places the slope is less than 15 percent.

Typically, the surface layer of the Pence soil is very dark gray, very friable sandy loam about 4 inches thick. The subsoil is very friable sandy loam about 16 inches thick. It is strong brown in the upper part and yellowish red in the lower part. The substratum to a depth of about 60 inches is yellowish red gravelly sand. In places the slope is less than 15 percent.

Typically, the surface layer of the Sarona soil is black, very friable fine sandy loam about 2 inches thick. The subsurface layer is dark brown, very friable fine sandy loam about 2 inches thick. The subsoil is about 26 inches thick. It is brown, friable fine sandy loam in the upper part and reddish brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish red, very friable loamy sand. In places the slope is less than 15 percent.

Included with these soils in mapping are small areas of Keweenaw, Menahga, and Padus soils. These included soils are in landscape positions similar to those of the Emmert, Pence, and Sarona soils. Keweenaw soils formed in sandy and loamy deposits.

Menahga soils are excessively drained and are sandy throughout. Padus soils formed in a loamy mantle 20 to 35 inches thick underlain by stratified sand or sand and gravel. Also included are areas of Emmert, Pence, and Sarona soils that have boulders in the surface layer. Included soils make up 10 to 15 percent of the unit.

Permeability is very rapid in the Emmert soil. It is moderately rapid in the subsoil of the Pence soil and rapid in the substratum. It is moderate in the Sarona soil. The available water capacity is very low in the Emmert soil, low in the Pence soil, and moderate in the Sarona soil.

Most areas of these soils are used as woodland. The substratum of the Emmert and Pence soils is a probable source of sand and gravel.

These soils are suited to trees. The main concerns in managing woodland are the hazard of water erosion and equipment limitations. Seedling mortality is a concern on the Emmert soil. The erosion results from the concentration of runoff on logging roads and skid trails, in tracks of wheeled equipment, and on landings. Removing the water by water bars, out-sloping road surfaces, culverts, and drop structures and building the roads and trails on the contour help to prevent excessive soil loss. Seeding exposed areas after logging helps to establish a protective vegetative cover. In areas where the slope limits the use of equipment, special logging methods, such as yarding the logs by cable, may be needed. The slope also limits the selection of sites for logging roads and landings. Logging roads can be designed so that they conform to the topography. The slope should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils. The use of equipment is restricted in spring and in other excessively wet periods by low strength in the Sarona soil. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soils are dry or the snow cover is thick. The seedling mortality rate can be reduced on the Emmert soil by planting when the soil is moist. Planting containerized seedlings or vigorous nursery stock can also reduce the seedling mortality rate.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species in areas of the Sarona soil. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

These soils generally are unsuited to cultivated crops because of the low or very low available water capacity and a severe hazard of water erosion. They are poorly suited to pasture. A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, depletes the plant cover and results in water erosion. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This map unit is poorly suited to septic tank absorption fields because of the slope and a poor filtering capacity in the Emmert and Pence soils. The slope can be overcome by cutting and filling or by installing a trench absorption system on the contour. Also, the absorption field can be installed in areas of the included soils where the slope is less than 15 percent. The Emmert and Pence soils readily absorb the effluent in septic tank absorption fields. They do not adequately filter the effluent, however, because of the rapid or very rapid permeability. The poor filtering capacity can result in the pollution of ground water. Because of the slope, the soils are poorly suited to dwellings and to local roads and streets. This limitation can be overcome by cutting and filling. Also, the dwellings or roads can be built in areas of the included soils where the slope is less than 15 percent.

The land capability classification is VIIs. The woodland ordination symbol is 6R for the Emmert soil, 3R for the Pence soil, and 3R for the Sarona soil. The primary habitat type is AQVib, and the secondary habitat type is ATM.

EmB—Emmet fine sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is on broad ridgetops and the side slopes of ridges on moraines and drumlins. Individual areas are oblong or irregular in shape and generally range from 3 to 640 acres in size.

Typically, the surface layer is very dark gray, very friable fine sandy loam about 3 inches thick. The subsurface layer is pinkish gray, very friable fine sandy loam about 1 inch thick. The subsoil is about 6 inches of brown, very friable fine sandy loam. The next 8 inches is light brownish gray and dark reddish brown, very friable and firm fine sandy loam. Below this is about 15 inches of dark reddish brown and yellowish red, friable fine sandy loam. The substratum to a depth of about 60 inches is reddish brown fine sandy loam. In some places the surface layer is loam or loamy fine

sand. In other places the slope is as much as 10 percent.

Included with this soil in mapping are small areas of Charlevoix, Cunard, Menominee, and Nadeau soils. The somewhat poorly drained Charlevoix soils are in depressions and drainageways. Cunard, Menominee, and Nadeau soils are in landscape positions similar to those of the Emmet soil. Cunard soils are underlain by dolomite at a depth of 20 to 40 inches. Menominee soils have a sandy mantle 20 to 40 inches thick. Nadeau soils have more gravel in the lower part of the subsoil than the Emmet soil. Also, they have more sand and gravel in the substratum. Also included are small areas of soils similar to the Emmet soil but which have a seasonal high water table at a depth of 3 feet. Included soils make up 1 to 15 percent of the unit.

Permeability is moderate in the upper part of the profile in the Emmet soil and moderate or moderately rapid in the lower part. Surface runoff is slow in cultivated areas. The available water capacity is moderate. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Areas of this soil are used as cropland, pasture, or woodland. This soil is the most commonly farmed in the county.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for all-weather roads, a gravel base is needed. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, water erosion is a slight or moderate hazard. It can be controlled by conservation tillage, a conservation cropping system, proper management of crop residue, contour farming, contour stripcropping, and grassed waterways. Regular additions of organic material help to maintain fertility and tilth and increase the rate of water infiltration.

A cover of pasture plants or hay helps to control water erosion (fig. 9). Overgrazing, however, depletes the plant cover. Grazing when the soil is wet results in compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to dwellings. It is only moderately suited to septic tank absorption fields because of the moderate permeability. Mounding with suitable filtering material or enlarging the absorption field helps to overcome this limitation. The soil is only moderately suited to local roads and streets because of a moderate potential for frost action. Covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 3L. The primary habitat type is AFD or AViO, and the secondary habitat type is ATD.

EmC—Emmet fine sandy loam, 6 to 12 percent slopes. This deep, sloping, well drained soil is on ridgetops and the side slopes of ridges on moraines and drumlins. Individual areas are elongated or irregular in shape and generally range from 3 to 160 acres in size.

Typically, the surface layer is dark brown, very friable fine sandy loam about 3 inches thick. The subsoil is about 21 inches thick. It is brown, very friable fine sandy loam in the upper part; dark reddish brown, friable sandy clay loam in the next part; and reddish brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown sandy loam. In some places the surface layer is loamy sand. In other places the slope is as little as 2 percent or as much as 15 percent.

Included with this soil in mapping are small areas of Charlevoix, Menominee, and Nadeau soils. The somewhat poorly drained Charlevoix soils are in depressions and drainageways. Menominee and Nadeau soils are in landscape positions similar to those of the Emmet soil. Menominee soils have a sandy mantle 20 to 40 inches thick. Nadeau soils have more gravel in the lower part of the subsoil than the Emmet soil. Also, they have more sand and gravel in the substratum. Included soils make up about 15 percent of the unit.

Figure 9.—An area of Emmet fine sandy loam, 1 to 6 percent slopes, used as hayland.

Permeability is moderate in the upper part of the profile in the Emmet soil and moderate or moderately rapid in the lower part. Surface runoff is medium in cultivated areas. The available water capacity is moderate. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Areas of this soil are used as woodland, cropland, or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted during excessively wet periods by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for all-weather roads, a gravel base is needed. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, water erosion is a moderate hazard. It can be controlled by conservation tillage, a conservation cropping system, proper management of crop residue, contour farming, contour stripcropping, and grassed waterways. Regular additions of organic material help to maintain fertility and tilth and increase the rate of water infiltration.

A cover of pasture plants or hay helps to control

water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet results in compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is only moderately suited to septic tank absorption fields because of the moderate permeability and the slope. Mounding with suitable filtering material or enlarging the absorption field helps to overcome the limited permeability. Installing a trench absorption system on the contour helps to overcome the slope. The soil is only moderately suited to dwellings because of the slope. Cutting and filling can overcome this limitation. The soil is only moderately suited to local roads and streets because of the slope and a moderate potential for frost action. Cutting and filling or constructing roads on the contour helps to overcome the slope. Covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3L. The primary habitat type is AFD or AViO, and the secondary habitat type is ATD.

EmD—Emmet fine sandy loam, 12 to 20 percent slopes. This deep, moderately steep, well drained soil is on the side slopes of ridges on moraines and drumlins. Individual areas are long and narrow and generally range from 3 to 80 acres in size.

Typically, the surface layer is dark brown, very friable fine sandy loam about 4 inches thick. The subsoil is about 20 inches thick. It is reddish brown, friable fine sandy loam in the upper part; yellowish red, friable loam in the next part; and brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown sandy loam. In places the slope is as little as 6 percent or as much as 25 percent.

Included with this soil in mapping are small areas of Menahga and Menominee soils. These soils are in landscape positions similar to those of the Emmet soil. Menahga soils are sandy throughout. Menominee soils have a sandy mantle 20 to 40 inches thick. Included soils make up 1 to 15 percent of the unit.

Permeability is moderate in the upper part of the profile in the Emmet soil and moderate or moderately rapid in the lower part. Surface runoff is very rapid in cultivated areas. The available water capacity is moderate.

Most areas of this soil are used as woodland. Some are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are the hazard of water erosion and equipment limitations. The erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing the water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads on the contour help to prevent excessive soil loss. Seeding exposed areas after logging helps to establish a protective vegetative cover. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary. The slope limits the selection of sites for logging roads and landings. Logging roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is poorly suited to corn and small grain because of a severe hazard of water erosion. It is suited to grasses and legumes for hay and pasture. Conservation tillage, a conservation cropping system, contour farming, contour stripcropping, diversions, terraces, and grassed waterways help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields, dwellings, and local roads and streets because of the slope. This limitation can be overcome by cutting and filling and by establishing septic tank absorption fields or roads on the contour. Also, the less sloping included areas can be selected as building sites.

The land capability classification is IVe. The woodland ordination symbol is 3R. The primary habitat type is AFD or AViO, and the secondary habitat type is ATD.

EmE—Emmet fine sandy loam, 20 to 30 percent slopes. This deep, steep, well drained soil is on the side slopes of ridges on moraines and drumlins. Individual areas are long and narrow and generally range from 3 to 120 acres in size.

Typically, the surface layer is very dark grayish brown, very friable fine sandy loam about 3 inches thick. The subsoil is about 21 inches thick. It is strong brown, very friable loam in the upper part; reddish brown, friable sandy clay loam in the next part; and brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is brown sandy loam. Some cleared areas show evidence of moderate erosion. In some places the surface layer is loamy sand. In other places the slope is as little as 15 percent or as much as 35 percent.

Included with this soil in mapping are small areas of Alpena, Menominee, and Nadeau soils. These soils are in landscape positions similar to those of the Emmet soil. Alpena and Nadeau soils have more gravel in the subsoil than the Emmet soil. Also, they have more sand and gravel in the substratum. Menominee soils have a sandy mantle 20 to 40 inches thick. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the profile in the Emmet soil and moderate or moderately rapid in the lower part. Surface runoff is very rapid. The available water capacity is moderate.

Most areas of this soil are used as woodland. Some are used as pasture.

This soil is suited to trees. The main concerns in managing woodland are the hazard of water erosion and equipment limitations. The erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing the water by water bars, outsloping road surfaces, ditches, and culverts and establishing logging roads on the contour help to prevent excessive soil loss. Seeding exposed areas after logging helps to establish a protective vegetative cover. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary. The slope limits the selection of sites for logging roads and landings. Logging roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is generally unsuitable for cultivated crops because of a very severe hazard of water erosion. It is suited to pasture and hay. A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields and dwellings because of the slope. This limitation is difficult to overcome. A more suitable site should be selected. The soil is poorly suited to local roads and streets because of the slope. Cutting and filling or constructing the roads on the contour helps to overcome this limitation.

The land capability classification is VIe. The woodland ordination symbol is 3R. The primary habitat type is AFD or AViO, and the secondary habitat type is ATD.

EoB—Emmet cobbly fine sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on ridgetops on moraines and drumlins. Dolomite cobbles are exposed on the surface. Individual areas are irregular in shape and generally range from 3 to 100 acres in size.

Typically, the surface layer is dark brown, very friable cobbly fine sandy loam about 7 inches thick. The subsoil is about 21 inches thick. It is brown, friable fine sandy loam in the upper part; reddish brown, friable loam in the next part; and brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is brown sandy loam. In places the slope is as much as 12 percent.

Included with this soil in mapping are small areas of Charlevoix and Nadeau soils. The somewhat poorly drained Charlevoix soils are in depressions and drainageways. Nadeau soils are in landscape positions

similar to those of the Emmet soil. They have more gravel in the lower part of the subsoil than the Emmet soil. Also, they have more sand and gravel in the substratum. Also included are areas of Emmet soils that have few or no cobbles in the surface layer. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the profile in the Emmet soil and moderate or moderately rapid in the lower part. Surface runoff is slow. The available water capacity is moderate. The surface layer is cobbly.

Most areas of this soil are used as woodland. A few are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for all-weather roads, a gravel base is needed. Cobbles on the surface also limit the use of equipment. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

If the cobbles in the surface layer are removed, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, water erosion is a slight or moderate hazard. Soil loss can be controlled by conservation tillage, a conservation cropping system, proper management of crop residue, contour farming, contour stripcropping, and grassed waterways. Regular additions of organic material help to maintain fertility and tilth and increase the rate of water infiltration.

This soil is suited to pasture. It should be managed for bluegrass in areas where cobbles interfere with the use of machinery. A cover of pasture plants or hay helps to control water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet results in compaction of the surface layer and increases the rate of runoff and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to dwellings. It is only moderately suited to septic tank absorption fields because of the moderate permeability. Mounding with suitable filtering material or enlarging the absorption field helps to overcome this limitation. The soil is only moderately suited to local roads and streets because of a moderate potential for frost action. Covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is VIs. The woodland ordination symbol is 3L. The primary habitat type is AFD or AViO, and the secondary habitat type is ATD.

EoC—Emmet cobbly fine sandy loam, 6 to 12 percent slopes. This deep, sloping, well drained soil is on the side slopes of ridges on moraines and drumlins. Dolomite cobbles are exposed on the surface. Individual areas are irregular in shape and generally range from 3 to 40 acres in size.

Typically, the surface layer is dark brown, very friable cobbly fine sandy loam about 2 inches thick. The subsurface layer is light brownish gray, very friable loam about 2 inches thick. The subsoil is about 20 inches thick. It is reddish brown, very friable sandy clay loam in the upper part and reddish brown, friable loam in the lower part. The substratum to a depth of about 60 inches is brown gravelly sandy loam. In places the slope is as little as 3 percent.

Included with this soil in mapping are small areas of Menominee and Nadeau soils. These soils are in landscape positions similar to those of the Emmet soil. Menominee soils have a sandy mantle 20 to 40 inches thick. Nadeau soils have more gravel in the lower part of the subsoil than the Emmet soil. Also, they have more sand and gravel in the substratum. Also included are areas of Emmet soils that have few or no cobbles in the surface layer. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the profile in the Emmet soil and moderate or moderately rapid in the lower part. Surface runoff is medium. The available water capacity is moderate. The surface layer is cobbly.

Most areas of this soil are used as woodland. A few are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted during excessively wet periods because of low strength. Ruts form easily when wheeled skidders are used during these periods. Deep

ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for all-weather roads, a gravel base is needed. Cobbles on the surface also limit the use of equipment. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

If the cobbles in the surface layer are removed, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, water erosion is a moderate hazard. Soil loss can be controlled by conservation tillage, a conservation cropping system, proper management of crop residue, contour farming, contour stripcropping, and grassed waterways. Regular additions of organic material help to maintain fertility and tilth and increase the rate of water infiltration.

This soil is suited to pasture. It should be managed for bluegrass in areas where cobbles interfere with the use of machinery. A cover of pasture plants or hay helps to control water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet results in compaction of the surface layer and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is only moderately suited to septic tank absorption fields because of the moderate permeability and the slope. Mounding with suitable filtering material or enlarging the absorption field helps to overcome the limited permeability. Installing a trench absorption system on the contour helps to overcome the slope. The soil is only moderately suited to dwellings because of the slope. Cutting and filling can overcome this limitation. The soil is only moderately suited to local roads and streets because of the slope and a moderate potential for frost action. Cutting and filling or constructing roads on the contour helps to overcome the slope. Covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is VIs. The woodland ordination symbol is 3L. The primary habitat type is AFD or AViO, and the secondary habitat type is ATD.

Ey—Ensley loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained and very poorly drained soil is in depressions and drainageways on ground moraines. It is subject to ponding. Individual areas are irregular in shape and generally range from 3 to 100 acres in size.

Typically, the surface layer is black, very friable loam about 5 inches thick. The subsoil is about 20 inches thick. It is dark grayish brown, mottled, friable loam in the upper part and grayish brown and reddish brown, mottled, very friable fine sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled fine sandy loam. In some places the surface layer is loamy sand. In other places the slope is as much as 4 percent.

Included with this soil in mapping are small areas of Brevort, Charlevoix, and Nahma soils. Brevort and Nahma soils are in landscape positions similar to those of the Ensley soil. Brevort soils are sandy in the upper 20 to 40 inches. Nahma soils are underlain by dolomite at a depth of 20 to 40 inches. Charlevoix soils are somewhat poorly drained. They are in the slightly higher landscape positions. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the subsoil of the Ensley soil and moderate or moderately rapid in the substratum. Surface runoff is very slow. The available water capacity is moderate. Unless the soil is drained, the root development for most crops is restricted by a seasonal high water table at or above the surface or within a depth of 1 foot.

Most areas of this soil are used as woodland. Some have been drained and are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The soil is usually wet most of the year. Ruts form easily when wheeled skidders are used during the wet periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. All-weather roads require a gravel base. Culverts are needed to maintain the natural drainage system. Wetness and low strength are severe limitations on landing sites. The adjacent soils are better suited as sites for landings. Trees generally are not planted on this soil because of the excessive

wetness. Reforestation is limited to natural regeneration or hand planting. Seedling mortality, which is caused by wetness, can be minimized by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

Unless drained, this soil is unsuited to cultivated crops. If drained, however, this soil is suited to corn and small grain and to legumes for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains can improve internal drainage, but some areas do not have suitable outlets. Diversions on the adjacent upland soils help to protect this soil against overflow.

If drained, this soil is suited to pasture and hay. Overgrazing depletes the plant cover and increases the extent of undesirable plant species. A drainage system, proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

Because of the ponding, this soil is generally unsuited to septic tank absorption fields and to dwellings. Overcoming this hazard may be difficult. A better suited site should be selected. The soil is poorly suited to local roads and streets because of the ponding and a high potential for frost action. These limitations can be overcome by constructing the roads and streets on raised, well compacted fill material. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is Vw, undrained. The woodland ordination symbol is 3W. A habitat type has not been assigned.

FsB—Fence silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on ridges in glacial lake basins and on outwash plains. Individual areas are oblong and generally range from 5 to 100 acres in size.

Typically, about 1 inch of partially decomposed forest litter is at the surface. The surface layer is black, very friable silt loam about 2 inches thick. The subsurface layer is reddish gray, very friable silt loam about 3 inches thick. The subsoil is about 12 inches of reddish brown, friable silt. The next 12 inches is reddish brown and yellowish red, friable silt and silt loam. Below this is about 10 inches of yellowish red, friable silt loam. The substratum to a depth of about 60 inches is reddish brown silt. In some places the surface layer is very fine sandy loam or fine sandy loam. In other places the slope is as much as 10 percent.

Included with this soil in mapping are small areas of Gaastra, Padus, and Rousseau soils. The somewhat poorly drained Gaastra soils are in depressions and drainageways. Padus and Rousseau soils are in landscape positions similar to those of the Fence soil. Padus soils have a loamy mantle 20 to 35 inches thick underlain by sandy and gravelly deposits. Rousseau soils are sandy throughout. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Fence soil. The available water capacity is moderate.

Most areas of this soil are used as woodland. This soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for all-weather roads, a gravel base is needed. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, water erosion is a slight or moderate hazard. It can be controlled by conservation tillage, a conservation cropping system, proper management of crop residue, contour farming, contour stripcropping, and grassed waterways. Regular additions of organic material help to maintain fertility and tilth and increase the rate of water infiltration.

A cover of pasture plants or hay helps to control water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet results in

compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to dwellings. It is poorly suited to septic tank absorption fields because of the moderately slow permeability. Mounding with suitable filtering material or enlarging the absorption field helps to overcome this limitation. The soil is poorly suited to local roads and streets because of a high potential for frost action. Covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 3L. The primary habitat type is ATD, and the secondary habitat type is ATM.

FsC—Fence silt loam, 6 to 15 percent slopes. This deep, sloping and moderately steep, well drained soil is on the side slopes of ridges in glacial lake basins and on outwash plains. Individual areas are long and narrow and generally range from 10 to 65 acres in size.

Typically, the surface layer is black, very friable silt loam about 1 inch thick. The subsurface layer is brown, very friable silt loam about 3 inches thick. The subsoil is about 32 inches thick. It is reddish brown, friable silt in the upper part and yellowish red, friable silt loam in the lower part. The substratum to a depth of about 60 inches is reddish brown silt. In some places the surface layer is fine sandy loam. In other places the slope is as little as 3 percent.

Included with this soil in mapping are small areas of Padus and Shawano soils. These soils are in landscape positions similar to those of the Fence soil. Padus soils have a loamy mantle 20 to 35 inches thick underlain by sandy and gravelly deposits. Shawano soils formed in deposits of sandy material, which is dominantly fine sand in size. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately slow in the Fence soil. The available water capacity is moderate.

Most areas of this soil are used as woodland. The soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted during excessively wet periods by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for all-weather roads, a gravel base is needed. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, water erosion is a moderate hazard. It can be controlled by conservation tillage, a conservation cropping system, proper management of crop residue, contour farming, contour stripcropping, and grassed waterways. Regular additions of organic material help to maintain fertility and tilth and increase the rate of water infiltration.

A cover of pasture plants or hay helps to control water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet results in compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is only moderately suited to dwellings with and without basements because of the slope. This limitation can be overcome by cutting and filling. The soil is poorly suited to septic tank absorption fields because of the moderately slow permeability. Mounding with suitable filtering material or enlarging the absorption field helps to overcome this limitation. The soil is poorly suited to local roads and streets because of a high potential for frost action. Covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3L. The primary habitat type is ATD, and the secondary habitat type is ATM.

Fw—Forada mucky loam, 0 to 1 percent slopes. This deep, nearly level, poorly drained and very poorly drained soil is in depressions and drainageways on outwash plains and ground moraines. It is subject to ponding. Individual areas are irregular in shape and

generally range from 3 to 80 acres in size.

Typically, the surface layer is black, very friable mucky loam about 9 inches thick. The subsoil is about 17 inches thick. It is dark grayish brown, mottled, friable loam in the upper part and grayish brown, mottled, very friable fine sandy loam in the lower part. The upper part of the substratum is yellowish brown, mottled sand. The lower part to a depth of about 60 inches is grayish brown gravelly coarse sand.

Included with this soil in mapping are small areas of Arnheim, Brevort, Deford, Ensley, and Markey soils. These soils are in landscape positions similar to those of the Forada soil. Arnheim soils formed in stratified silty and sandy alluvial deposits. Brevort soils are sandy in the upper 20 to 40 inches and are underlain by loamy deposits. Deford soils are sandy throughout. Ensley soils have a loamy substratum. Markey soils are muck to a depth of 16 to 51 inches. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Forada soil and rapid in the substratum. The available water capacity is low. Unless the soil is drained, the root development for most crops is restricted by a seasonal high water table that is at or above the surface or within a depth of 1 foot.

Most areas of this soil are used as woodland. The soil is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The soil is usually wet most of the year. Ruts form easily when wheeled skidders are used during the wet periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. All-weather roads require a gravel base. Culverts are needed to maintain the natural drainage system. Wetness and low strength are severe limitations on landing sites. The better suited adjacent soils may be needed as sites for landings. Trees generally are not planted on this soil because of the excessive wetness. Reforestation is limited to natural regeneration or hand planting. Seedling mortality, which is caused by wetness, can be minimized by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

Unless drained, this soil is unsuited to cultivated crops. If drained, it is suited to corn and small grain and to legumes and grasses for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches can improve internal drainage. Ditchbanks are easily eroded, and vertical banks cave in and plug the ditch. Areas that are drained and cultivated are subject to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

If drained, this soil is suited to pasture and hay. Forage yields are restricted unless fertilizer and irrigation water are applied. Overgrazing depletes the plant cover and results in soil blowing. Drainage systems, proper stocking rates, pasture rotation, and timely deferment of grazing are needed to keep the pasture in good condition.

Because of the ponding, this soil is poorly suited to septic tank absorption fields and dwellings. Overcoming this hazard is difficult. A better suited site should be selected. The soil is poorly suited to local roads and streets because of the ponding and a high potential for frost action. These limitations can be overcome by constructing the roads and streets on raised, well compacted fill material. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is VIw, undrained. The woodland ordination symbol is 3W. A habitat type has not been assigned.

GaA—Gaastra silt loam, 0 to 3 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is in depressions and drainageways in glacial lake basins, on ground moraines, and on outwash plains. Individual areas are irregular in shape and generally range from 5 to 60 acres in size.

Typically, the surface layer is very dark gray, very friable silt loam about 3 inches thick. The subsurface layer is gray, mottled, very friable silt loam about 2 inches thick. The subsoil is about 6 inches of strong brown, mottled, very friable silt loam. The next 2 inches is pale brown, mottled, very friable silt loam. Below this is about 13 inches of reddish brown, mottled, friable silt loam. The substratum to a depth of about 60 inches is

reddish brown silt loam. In some places the surface layer is very fine sandy loam. In other places the slope is as much as 6 percent.

Included with this soil in mapping are small areas of the poorly drained and very poorly drained Bruce soils and the well drained Fence soils. Bruce soils are in the lower areas. Fence soils are in the higher landscape positions. Included soils make up 2 to 15 percent of the unit.

Permeability is moderately slow in the Gaastra soil. The available water capacity is moderate. Unless the soil is drained, the root development for most crops is restricted by a seasonal high water table at a depth of 1 to 2 feet.

Most areas of this soil are used as woodland. Some have been drained and are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations and the windthrow hazard. The use of equipment is restricted in spring, in late fall, and in other excessively wet periods by the perched seasonal high water table and by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for year-round roads, a gravel base is needed. Culverts are needed to maintain the natural drainage system. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment. Also, they can be established on the better suited adjacent soils. A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

If drained, this soil is suited to corn and small grain and to legumes and grasses for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains can improve internal drainage. Ditchbanks are easily eroded unless they are protected by a vegetative cover. Proper management of crop residue and additions of other organic material improve tilth and fertility and increase the organic matter content and the rate of water infiltration.

If drained, this soil is suited to pasture and hay. Overgrazing depletes the plant cover and increases the extent of undesirable plant species. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and reduces the rate of water infiltration. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields because of the seasonal high water table. Overcoming this limitation is difficult. A better suited site should be considered. The soil is poorly suited to dwellings because of the wetness. This limitation can be overcome by constructing dwellings without basements, building on fill material, or constructing the basements above the level of wetness. The wetness also can be overcome by installing tile drains around the foundations and providing gravity outlets or other dependable outlets. Installing a drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or gravel, help to prevent the damage to local roads and streets caused by a high potential for frost action.

The land capability classification is IIw. The woodland ordination symbol is 3W. The habitat type is TMC.

GmB—Goodman silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on broad ridges on ground moraines. Individual areas are irregular in shape and generally range from 10 to 300 acres in size.

Typically, about 1 inch of partially decomposed leaf litter is at the surface. The surface layer is black, very friable silt loam about 4 inches thick. The subsurface layer is brown, very friable silt loam about 2 inches thick. The subsoil is about 6 inches of dark reddish gray, friable silt loam and about 14 inches of brown, friable loam. The next 10 inches is pinkish gray and brown, friable silt loam. Below this is about 2 inches of reddish brown, very friable fine sandy loam. The substratum to a depth of about 60 inches is reddish brown sandy loam. In some places the surface layer is fine sandy loam or loam. In other places the slope is as much as 12 percent.

Included with this soil in mapping are small areas of Michigamme, Monico, and Sarona soils. Michigamme soils are underlain by igneous or metamorphic bedrock at a depth of 20 to 40 inches. They are near rock

outcrops. The somewhat poorly drained Monico soils are in depressions and drainageways. Sarona soils have more sand and less silt in the upper part of the solum than the Goodman soil. They are in landscape positions similar to those of the Goodman soil. Also included are areas of Goodman soils that have stones and boulders exposed on the surface. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Goodman soil. The available water capacity is moderate.

Most areas of this soil are used as woodland. The soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. When the soil is wet, unsurfaced roads are slippery and ruts form easily. On sites for all-weather roads, a gravel base is needed. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, water erosion is a slight or moderate hazard. It can be controlled by conservation tillage, a conservation cropping system, proper management of crop residue, contour farming, contour stripcropping, and grassed waterways. Regular additions of organic material help to maintain fertility and tilth and increase the rate of water infiltration.

A cover of pasture plants or hay helps to control water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet results in compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to dwellings. It is only moderately suited to septic tank absorption fields because of the moderate permeability. Mounding with suitable filtering material and enlarging the absorption field help to overcome this limitation. The soil is only moderately suited to local roads and streets because of a moderate potential for frost action. Covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 3L. The habitat type is AViO.

GmC—Goodman silt loam, 6 to 15 percent slopes. This deep, sloping and moderately steep, well drained soil is on the side slopes of ridges on ground moraines. Individual areas are irregular in shape and generally range from 10 to 160 acres in size.

Typically, the surface layer is black, very friable silt loam about 2 inches thick. The subsurface layer is grayish brown, very friable silt loam about 4 inches thick. The subsoil is about 43 inches thick. It is brown, very friable silt loam in the upper part; light brown and reddish brown, very friable silt loam in the next part; and brown, very friable fine sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown sandy loam. In places the slope is as little as 3 percent.

Included with this soil in mapping are small areas of Michigamme, Padus, and Sarona soils. Michigamme soils are underlain by igneous or metamorphic bedrock at a depth of 20 to 40 inches. They are near rock outcrops. Padus and Sarona soils are in landscape positions similar to those of the Goodman soil. Padus soils are underlain by sand or by sand and gravel at a depth of 20 to 35 inches. Sarona soils have more sand and less silt in the upper part of the solum than the Goodman soil. Also included are areas of Goodman soils that have stones and boulders exposed on the surface. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Goodman soil. The available water capacity is moderate.

Most areas of this soil are used as woodland. The soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted during excessively wet periods because of low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for all-weather roads, a gravel base is needed. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, water erosion is a slight or moderate hazard. It can be controlled by conservation tillage, a conservation cropping system, proper management of crop residue, contour farming, contour stripcropping, and grassed waterways. Regular additions of organic material help to maintain fertility and tilth and increase the rate of water infiltration.

A cover of pasture plants or hay helps to control water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet results in compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is only moderately suited to septic tank absorption fields because of the moderate permeability and the slope. Mounding with suitable filtering material or enlarging the absorption field helps to overcome the limited permeability. Installing a trench absorption system on the contour helps to overcome the slope. The soil is only moderately suited to dwellings because of the slope. Cutting and filling can overcome this limitation. The soil is only moderately suited to local roads and streets because of the slope and a moderate potential for frost action. Cutting and filling or constructing roads on the contour helps to overcome the slope. Covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3L. The habitat type is AViO.

HbB—Hibbing silt loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is on ridges in glacial lake basins. Individual areas are irregular in shape and generally range from 5 to 60 acres in size.

Typically, the surface layer is dark brown, very friable silt loam about 3 inches thick. The subsurface layer is reddish brown, very friable silt loam about 2 inches thick. The next 13 inches is reddish gray, firm silty clay loam and reddish brown, firm silty clay. The subsoil is reddish brown, firm silty clay about 17 inches thick. The substratum to a depth of about 60 inches is reddish brown silty clay. In some places the surface layer is fine sandy loam or very fine sandy loam. In other places the slope is as much as 10 percent.

Included with this soil in mapping are small areas of Manistee and Selkirk soils. Manistee soils have a sandy mantle 20 to 40 inches thick. They are in landscape positions similar to those of the Hibbing soil. The somewhat poorly drained Selkirk soils are in depressions and drainageways. Included soils make up 1 to 15 percent of the unit.

Permeability is slow in the Hibbing soil. The available water capacity is moderate.

Most areas of this soil are used as woodland. The soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for all-weather roads, a gravel base is needed. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, water erosion is a moderate hazard. It can be controlled by conservation tillage, a conservation cropping system, proper management of crop residue, contour farming, contour stripcropping, and grassed waterways. Regular additions of organic material help to maintain fertility and tilth, reduce crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay helps to control water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet results in compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the slow permeability. Mounding with suitable filtering material or enlarging the absorption field helps to overcome this limitation. The soil is poorly suited to dwellings because of a high shrink-swell potential. This limitation can be overcome by placing a layer of coarse material, such as sand or gravel, under and around the foundations. Installing tile drains around the foundations helps to remove excess water. The soil is also poorly suited to local roads and streets because of low strength and the high shrink-swell potential. These limitations can be overcome by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel.

The land capability classification is IIe. The woodland ordination symbol is 6L. The habitat type is ATM.

IsA—Iosco loamy fine sand, 0 to 3 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is in depressions and drainageways on ground moraines and outwash plains. Individual areas are irregular in shape and generally range from 3 to 80 acres in size.

Typically, the surface layer is very dark brown, very friable loamy fine sand about 9 inches thick. The subsoil is about 19 inches thick. It is brown, mottled, very friable fine sand in the upper part; brown, mottled, very friable fine sand in the next part; and reddish brown, mottled, friable loam in the lower part. The substratum to a depth of about 60 inches is brown, mottled fine sandy loam.

Included with this soil in mapping are small areas of Brevort, Charlevoix, Menominee, and Wainola soils. Brevort soils are poorly drained and very poorly drained. They are in the lower areas. Charlevoix and Wainola soils are in landscape positions similar to those of the Iosco soil. Charlevoix soils are loamy throughout. Wainola soils are sandy throughout. The well drained Menominee soils are on small ridges. Included soils make up 2 to 15 percent of the unit.

Permeability is rapid in the sandy upper layers in the Iosco soil and moderate in the loamy part of the subsoil and in the substratum. Surface runoff is slow. The available water capacity is moderate. The root development for most crops is restricted by a seasonal high water table at a depth of 1 to 3 feet.

Undrained areas of this soil are used as woodland or have been cleared and are used for unimproved pasture. Drained areas are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations and the windthrow hazard. The use of equipment is restricted in spring and in other excessively wet periods by the seasonal high water table. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. A shallow rooting depth, which is caused by the high water table, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control plant competition. Subsequent invading species should be controlled.

If drained, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. Surface drains remove excess surface water rapidly. Open ditches and tile drains can improve subsurface drainage. Where tile drains are installed, loose sand can enter the tile lines unless a suitable filter is used. Unless protected by a plant cover, ditchbanks are easily eroded by flowing water. Vertical banks can cave in and plug the ditch. Areas that are drained and cultivated are subject to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

If drained, this soil is suited to pasture and hay. Overgrazing depletes the plant cover and results in soil blowing. Drainage systems, proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields and dwellings because of the seasonal high water table. On sites for septic tank absorption fields where the seasonal high water table is below a depth of 2 feet, this limitation can be overcome by constructing a mound of suitable filtering material. On building sites the wetness can be overcome by constructing dwellings without basements, building on fill material, or constructing the basements above the level of wetness. The wetness also can be overcome by installing tile drains around the foundations and providing gravity outlets or other dependable outlets. Installing a drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or gravel, help to prevent the damage to local roads and streets caused by a high potential for frost action.

The land capability classification is IIIw. The woodland ordination symbol is 4W. The primary habitat type is TMC, and the secondary habitat type is ATM.

IxC—Ishpeming-Rock outcrop complex, 4 to 15 percent slopes. This map unit consists of areas of a moderately deep, gently sloping to moderately steep, somewhat excessively drained Ishpeming soil and igneous bedrock outcrops. The Ishpeming soil is on ridges and the side slopes of ridges on outwash plains and moraines. Individual areas are mainly irregular in shape and generally range from 5 to 960 acres in size. They are 50 to 80 percent Ishpeming loamy fine sand and 15 to 35 percent Rock outcrop. The Ishpeming soil and Rock outcrop occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the surface layer of the Ishpeming soil is very dark gray, very friable loamy fine sand about 3 inches thick. The subsurface layer is pinkish gray, very friable loamy fine sand about 3 inches thick. The subsoil is about 18 inches thick. It is dark reddish brown and reddish brown, very friable loamy fine sand in the upper part and reddish brown, very friable fine sand in the lower part. The substratum is brown fine sand about 12 inches thick. Granite bedrock is at a depth of about 36 inches. In places the surface layer is sand or fine sand.

Typically, the Rock outcrop is exposed granite bedrock (fig. 10). In places it is metamorphic bedrock. Some rock outcrops are escarpments that have a vertical face of as much as 100 feet.

Included with this unit in mapping are small areas of Au Gres, Menahga, Roscommon, Rousseau, and Shawano soils. These soils are sandy throughout and are not underlain by granite within a depth of 60 inches. The somewhat poorly drained Au Gres soils are in or adjacent to depressions and drainageways. The excessively drained Menahga and Shawano soils and the moderately well drained Rousseau soils are in landscape positions similar to those of the Ishpeming soil. The poorly drained and very poorly Roscommon soils are in depressions and drainageways. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Ishpeming soil. The available water capacity is low. The root development for most crops is restricted within a depth of 20 to 40 inches by the underlying granite or metamorphic bedrock.

Areas of this unit are used as woodland. The Ishpeming soil is suited to trees. Trees of commercial quality do not grow in areas of rock outcrops. The main concerns in managing woodland are equipment limitations. The bedrock escarpments severely restrict the movement of logging equipment. Logging roads should be carefully located so that the hazardous escarpments are avoided.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

The Ishpeming soil is unsuitable as cropland and pasture because of the low available water capacity and because tillage is hindered by the many outcrops of igneous or metamorphic bedrock.

The Ishpeming soil is poorly suited to septic tank absorption fields because of the rapid permeability and the moderate depth to bedrock. These limitations can be overcome by mounding the site with suitable filtering material. Also, in some areas the effluent can be pumped to an absorption field on a better suited site. The Ishpeming soil is poorly suited to dwellings with basements because of the moderate depth to hard bedrock. This limitation can be overcome by adding fill material, which can raise the site, or by constructing the dwellings with only partially exposed basements. This soil is only moderately suited to dwellings without basements because of the slope and the moderate depth to hard bedrock. These limitations can be overcome by leveling or adding coarse fill material, which can result in a level base deep enough for footings. The soil is only moderately suited to local roads and streets because of the depth to bedrock and the slope. These limitations can be overcome by shaping the roadway by cutting and filling. The underlying hard bedrock, however, limits the depth of cuts. Roads can also be constructed on the contour or in the less sloping areas of this unit. Straight roads may not be possible because of the rock outcrops.

The land capability classification is VIIs. The woodland ordination symbol is 5A for the Ishpeming soil. The primary habitat type is AQV, and the secondary habitat type is PMV.

KaB—Karlin loamy fine sand, 2 to 6 percent slopes. This deep, gently sloping, somewhat excessively drained soil is on ridges and flats on moraines and outwash plains. Individual areas are irregular in shape and generally range from 10 to 160 acres in size.

Typically, the surface layer is black, very friable loamy fine sand about 2 inches thick. The subsurface

Figure 10.—Typical outcrop of igneous rock in an area of Ishpeming-Rock outcrop complex, 4 to 15 percent slopes.

layer is brown, friable loamy fine sand about 1 inch thick. The subsoil is brown and reddish brown, friable loamy fine sand about 27 inches thick. The substratum to a depth of about 60 inches is light yellowish brown sand. In some places the surface layer is sandy loam or loam. In other places the slope is as much as 10 percent.

Included with this soil in mapping are small areas of Croswell, Menahga, Padus, and Pence soils. The moderately well drained Croswell soils are in the slightly lower positions on the landscape. Menahga, Padus, and Pence soils are in landscape positions similar to those of the Karlin soil. Menahga soils are excessively drained. The well drained Padus soils have a loamy mantle 20 to 35 inches thick. The well drained Pence soils have a loamy mantle 12 to 20 inches thick. Included soils make up 2 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the

Karlin soil and rapid in the substratum. The available water capacity is low.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. Some areas have been planted to red pine.

This soil is suited to trees. No major concerns affect the management of woodland. The low available water capacity, however, limits the growth of trees, especially hardwoods. Hardwoods do not grow as well as conifers on the more droughty soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture, but crop yields are limited by the low available water capacity. Applications of fertilizer and irrigation water improve productivity. The soil is suited to sprinkler irrigation. Because of the moderately rapid and rapid permeability, the irrigation rate should be limited. Limiting the rate helps to prevent the leaching of plant nutrients from the root zone. Water erosion generally is not a problem, but soil blowing is a hazard. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling soil blowing. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless irrigation water is applied. Overgrazing depletes the plant cover and results in soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is suited to dwellings and to local roads and streets. The effluent in septic tank absorption fields drains satisfactorily through the soil, but it can pollute ground water because of the rapid permeability in the substratum.

The land capability classification is IIIs. The woodland ordination symbol is 3A. The primary habitat type is PMV, and the secondary habitat type is AQV.

KaC—Karlin loamy fine sand, 6 to 15 percent slopes. This deep, sloping and moderately steep, somewhat excessively drained soil is on the side slopes of ridges on moraines and outwash plains. Individual areas are oblong and generally range from 10 to 320 acres in size.

Typically, the surface layer is black, very friable loamy fine sand about 2 inches thick. The subsurface layer is brown, very friable loamy fine sand about 1 inch thick. The subsoil is about 22 inches thick. It is brown, very friable loamy fine sand in the upper part and strong brown, friable loamy sand in the lower part. The substratum to a depth of about 60 inches is reddish yellow sand. In some places the surface layer is sandy loam or loam. In other places the slope is as little as 2 percent.

Included with this soil in mapping are small areas of Menahga and Pence soils. These soils are in landscape positions similar to those of the Karlin soil. Menahga soils are excessively drained. The well drained Pence soils have a loamy mantle 12 to 20 inches thick. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Karlin soil and rapid in the substratum. The available water capacity is low.

Most areas of this soil are used as woodland. A few are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. Some areas have been planted to red pine.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations. The slope limits the selection of landing sites. Landings can be established on the nearly level and gently sloping included or adjacent soils. After trees are cut, plant competition can delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture, but crop yields are limited by the low available water capacity. Applications of fertilizer and irrigation water improve productivity. The soil is suited to sprinkler irrigation. Because of the moderately rapid and rapid permeability, the irrigation rate should be limited. Limiting the rate helps to prevent the leaching of plant nutrients from the root zone. Water erosion is a moderate hazard. The soil is also subject to soil blowing. Conservation tillage, a conservation cropping system, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in

controlling soil blowing. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless irrigation water is applied. Overgrazing depletes the plant cover and results in soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

The effluent in septic tank absorption fields drains satisfactorily through this soil, but it can pollute ground water because of the rapid permeability in the substratum. The soil is only moderately suited to dwellings and to local roads and streets because of the slope. This limitation can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required.

The land capability classification is IIIe. The woodland ordination symbol is 3A. The primary habitat type is PMV, and the secondary habitat type is AQV.

KeB—Keweenaw loamy sand, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is on broad ridges on ground moraines and water-worked end moraines. Individual areas are irregular in shape and generally range from 10 to 160 acres in size.

Typically, about 3 inches of black, decomposed forest litter is at the surface. The surface layer is very dark gray, very friable loamy sand about 4 inches thick. The subsurface layer is grayish brown, very friable loamy sand about 3 inches thick. The subsoil is about 17 inches thick. It is dark brown, friable loamy sand in the upper part and strong brown, very friable loamy sand in the lower part. The next 12 inches is reddish brown, friable sandy loam. The substratum to a depth of about 60 inches is yellowish red loamy sand. In places the slope is as much as 10 percent.

Included with this soil in mapping are small areas of Menahga and Sarona soils. These soils are in landscape positions similar to those of the Keweenaw soil. The excessively drained Menahga soils are sandy throughout. Sarona soils are loamy in the upper part. Also included are areas of Keweenaw soils that have stones or boulders in or on the surface layer. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the upper part of the profile in the Keweenaw soil and moderately rapid in the substratum. The available water capacity is low.

Most areas of this soil are used as woodland. The substratum is a probable source of sand and gravel.

This soil is suited to trees. No major concerns affect the management of woodland. The low available water capacity, however, limits the growth of trees, especially hardwoods. Hardwoods do not grow as well as conifers on the more droughty soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is suited to corn and small grain and to legumes and grasses for hay and pasture, but crop yields are limited by the low available water capacity. Applications of fertilizer and irrigation water improve productivity. The soil is suited to sprinkler irrigation. If the soil is cultivated, water erosion is a slight or moderate hazard and soil blowing can occur. Conservation tillage, a conservation cropping system, winter cover crops, proper management of crop residue, contour stripcropping, wind stripcropping, field windbreaks, and grassed waterways help to prevent excessive soil loss.

This soil is suited to grasses and legumes for pasture and hay, but forage yields are limited by the low available water capacity. Overgrazing depletes the plant cover and results in water erosion and soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to dwellings and to local roads and streets. It is only moderately suited to septic tank absorption fields because of the moderate permeability. Enlarging the absorption field helps to overcome this limitation.

The land capability classification is IIIe. The woodland ordination symbol is 3A. The primary habitat type is AQV, and the secondary habitat type is PMV.

KeC—Keweenaw loamy sand, 6 to 15 percent slopes. This deep, sloping and moderately steep, well drained soil is on the side slopes of ridges on ground moraines and water-worked end moraines. Individual areas are irregular in shape and generally range from 5 to 500 acres in size.

Typically, the surface layer is black, very friable loamy sand about 1 inch thick. The subsurface layer is dark brown, very friable loamy sand about 3 inches thick. The subsoil is about 25 inches thick. It is yellowish red, very friable loamy sand in the upper part; reddish brown, very friable loamy sand in the next part;

and brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is dark yellowish brown loamy sand. In places the slope is as little as 2 percent or as much as 20 percent.

Included with this soil in mapping are small areas of Menahga and Sarona soils. These soils are in landscape positions similar to those of the Keweenaw soil. The excessively drained Menahga soils are sandy throughout. Sarona soils are loamy in the upper part of the profile. Also included are areas of Keweenaw soils that have stones and boulders in or on the surface layer. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the upper part of the profile in the Keweenaw soil and moderately rapid in the substratum. The available water capacity is low.

This soil is used as woodland. It is suited to trees. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils. After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is poorly suited to corn and small grain because of a moderate or severe hazard of water erosion. Crop yields are limited by the low available water capacity. Applications of fertilizer and irrigation water improve productivity. The soil is suited to sprinkler irrigation. If the soil is cultivated, water erosion and soil blowing can occur. Conservation tillage, a conservation cropping system, winter cover crops, proper management of crop residue, contour stripcropping, wind stripcropping, field windbreaks, and grassed waterways help to prevent excessive soil loss.

This soil is suited to grasses and legumes for pasture and hay, but forage yields generally are limited by the low available water capacity. Overgrazing depletes the plant cover and results in water erosion and soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and timely deferment of grazing help to keep the pasture in good condition.

This soil is only moderately suited to septic tank absorption fields because of the moderate permeability and the slope. Mounding with suitable filtering material or enlarging the absorption field helps to overcome the limited permeability. Installing a trench absorption system on the contour helps to overcome the limitation of slope. The soil is only moderately suited to dwellings and to local roads and streets because of slope. This limitation can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting and filling required.

The land capability classification is IVe. The woodland ordination symbol is 3A. The primary habitat type is AQV, and the secondary habitat type is PMV.

KeD—Keweenaw loamy sand, 15 to 25 percent slopes. This deep, moderately steep and steep, well drained soil is on uneven side slopes of ridges on ground moraines and water-worked end moraines. Individual areas are long and narrow or irregular in shape and generally range from 10 to 640 acres in size.

Typically, the surface layer is very dark gray, very friable loamy sand about 2 inches thick. The subsurface layer is dark grayish brown, very friable loamy sand about 1 inch thick. The subsoil is about 31 inches thick. It is brown, very friable loamy sand in the upper part; reddish brown, very friable sandy loam in the next part; and reddish brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is reddish brown loamy sand. In some places the surface layer is very fine sandy loam. In other places the slope is as little as 6 percent.

Included with this soil in mapping are small areas of Menahga and Sarona soils. These soils are in landscape positions similar to those of the Keweenaw soil. The excessively drained Menahga soils are sandy throughout. Sarona soils are loamy in the upper part of the profile. Also included are areas of Keweenaw soils that have stones and boulders in or on the surface layer. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the upper part of the profile in the Keweenaw soil and moderately rapid in the substratum. The available water capacity is low.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are the hazard of water erosion and equipment limitations. The erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing the water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads on the contour help to prevent excessive soil loss. Seeding exposed areas after logging helps to establish a protective vegetative cover. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary. The slope limits the selection of sites for logging roads and landings. Logging roads can be designed so that they conform to the topography. The

grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is generally unsuitable for cultivated crops because of the low available water capacity, a severe hazard of water erosion, and the hazard of soil blowing.

A cover of pasture plants or hay is effective in controlling water erosion and soil blowing. Overgrazing, however, depletes the plant cover. Forage yields generally are limited by the low available water capacity.

This soil is poorly suited to septic tank absorption fields, dwellings, and local roads and streets because of the slope. This limitation can be overcome by cutting and filling, by land shaping, and by establishing septic tank absorption fields or roads on the contour. Also, the less sloping included or adjacent soils can be selected as building sites.

The land capability classification is VIe. The woodland ordination symbol is 3R. The primary habitat type is AQV, and the secondary habitat type is PMV.

Ls—Loxley and Dawson peats, 0 to 1 percent slopes. These deep, nearly level, very poorly drained soils are in depressions and drainageways in glacial lake basins, on moraines, and on outwash plains. They are subject to ponding. Individual areas are circular or irregular in shape and generally range from 3 to 120 acres in size. A single mapped area may be either Loxley or Dawson peat, or it may contain both soils. The two soils have similar behavior characteristics for present and anticipated uses, and it was not considered practical or necessary to map them separately.

Typically, the upper layer of the Loxley soil is very pale brown peat about 11 inches thick. The next layer is brown peat about 4 inches thick. The lower layers to a depth of about 60 inches are dark reddish brown and black muck.

Typically, the upper layer of the Dawson soil is very pale brown peat about 8 inches thick. The next layers are very dark brown and black muck about 28 inches thick. The substratum to a depth of about 60 inches is pale brown sand.

Included with these soils in mapping are small areas of Au Gres, Croswell, Deford, and Roscommon soils. The somewhat poorly drained Au Gres soils and the moderately well drained Croswell soils are in the slightly higher positions on the landscape. Au Gres and Croswell soils are sandy throughout. The poorly drained and very poorly drained Deford and Roscommon soils are in landscape positions similar to those of the Loxley and Dawson soils. They are sandy throughout. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately slow to moderately rapid in the Loxley soil. It is moderately slow to moderately rapid in the organic material in the Dawson soil and rapid in the sandy substratum. The available water capacity is very high in both soils. A seasonal high water table is at or above the surface or within a depth of 1 foot throughout the year.

Most areas of these soils support low-growing wetland vegetation, mainly sphagnum moss, leatherleaf, bog rosemary, and widely spaced, stunted black spruce and tamarack. In some areas the sphagnum moss is collected for horticultural uses.

Because of the extremely acid soil conditions and the high water table, these soils generally are unsuited to trees. They do not support trees of merchantable size or quality.

These soils are generally unsuited to cropland and pasture because of the high water table and the frequent ponding. Most areas do not have a suitable outlet for drainage.

These soils are generally unsuited to septic tank absorption fields because of the ponding; to dwellings because of the subsidence, the ponding, and low strength; and to local roads and streets because of the subsidence, the ponding, and a high potential for frost action. Overcoming these limitations is difficult. A more suitable site should be selected.

The land capability classification is VIIw. A woodland ordination symbol or habitat type has not been assigned.

McB—Mancelona loamy sand, 0 to 6 percent slopes. This deep, nearly level and gently sloping, somewhat excessively drained soil is on flats and ridgetops on outwash plains, stream terraces, and moraines. Individual areas are irregular in shape and generally range from 3 to 500 acres in size.

Typically, the surface layer is black, very friable loamy sand about 6 inches thick. The subsoil is about 33 inches thick. It is dark brown and dark reddish brown, very friable loamy sand in the upper part and dark yellowish brown, very friable sand in the lower part. The substratum to a depth of about 60 inches is pale brown gravelly sand. In places the slope is as much as 10 percent.

Included with this soil in mapping are small areas of Banat, Menahga, and Nadeau soils. The somewhat poorly drained Banat soils are in depressions and drainageways. They are loamy in the upper part of the profile. They have more gravel in the subsoil and substratum than the Mancelona soil. Menahga and Nadeau soils are in landscape positions similar to those of the Mancelona soil. Menahga soils are excessively drained. They have a substratum that is more acid than that of the Mancelona soil. Nadeau soils have a loamy mantle 10 to 25 inches thick. They have more gravel in the lower part of the subsoil and in the substratum than the Mancelona soil. Included soils make up 2 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Mancelona soil and very rapid in the substratum. Surface runoff is slow. The available water capacity is low. The surface layer is very friable and can be easily tilled. The root development for most crops is restricted by the droughtiness of the gravelly sand below a depth of 20 to 40 inches.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. Some areas have been planted to red pine. The substratum is a probable source of sand and gravel.

This soil is suited to trees. No major concerns affect the management of woodland. The low available water capacity, however, limits the growth of trees, especially hardwoods. Hardwoods do not grow as well as conifers on the more droughty soils.

After trees are cut, plant competition can delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture, but crop yields are limited by the low available water capacity. If irrigated, the soil can produce better and more consistent yields. If the soil is cultivated, water erosion is a slight hazard and soil blowing can occur. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling soil blowing. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless irrigation water is applied. Overgrazing depletes the plant cover and results in soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

The soil is suited to dwellings and to local roads and streets. The effluent in septic tank absorption fields drains satisfactorily through the soil, but it can pollute ground water because of the very rapid permeability in the substratum.

The land capability classification is IIIs. The woodland ordination symbol is 3A. The primary habitat type is AQV, and the secondary habitat type is PMV.

McC—Mancelona loamy sand, 6 to 12 percent slopes. This deep, sloping, somewhat excessively drained soil is on the side slopes of ridges on outwash plains, stream terraces, and moraines. Individual areas are elongated and generally range from 3 to 160 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy sand about 4 inches thick. The subsoil is about 26 inches thick. It is brown, very friable loamy sand in the upper part; dark brown, friable loamy sand in the next part; and dark brown, very friable coarse sand in the lower part. The substratum to a depth of about 60 inches is brown gravelly sand. In places the slope is as little as 3 percent or as much as 15 percent.

Included with this soil in mapping are small areas of Menahga and Nadeau soils. These soils are in landscape positions similar to those of the Mancelona soil. Menahga soils are excessively drained. They have a substratum that is more acid than that of the Mancelona soil. Nadeau soils have a loamy mantle 10 to 25 inches thick. They have more gravel in the lower part of the subsoil and in the substratum than the Mancelona soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Mancelona soil and very rapid in the substratum. Surface runoff is medium in cultivated areas. The available water capacity is low. The surface layer is very friable and can be easily tilled, but it is erosive. The root development for most crops is restricted by the droughtiness of the gravelly sand below a depth of 20 to 40 inches.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. Some areas have been planted to red pine. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils. After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture, but crop yields are limited by the low available water capacity. If irrigated, the soil can produce better and more consistent yields. If the soil is cultivated, water erosion is a slight or moderate hazard and soil blowing can occur. Conservation tillage, a conservation cropping system, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling water erosion and soil blowing. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless irrigation water is applied. Overgrazing depletes the plant cover and results in water erosion and soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

The effluent in septic tank absorption fields drains satisfactorily through this soil, but it can pollute ground water because of the very rapid permeability in the substratum. The soil is only moderately suited to dwellings and to local roads and streets because of the slope. This limitation can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required.

The land capability classification is IIIe. The woodland ordination symbol is 3A. The primary habitat type is AQV, and the secondary habitat type is PMV.

McD—Mancelona loamy sand, 12 to 20 percent slopes. This deep, moderately steep, somewhat excessively drained soil is on the side slopes of ridges on outwash plains, stream terraces, and moraines. Individual areas are long and narrow and generally range from 3 to 80 acres in size.

Typically, the surface layer is brown, very friable loamy sand about 4 inches thick. The subsoil is about 25 inches thick. It is strong brown, very friable loamy sand in the upper part; brown, friable loamy sand in the next part; and reddish brown, very friable sandy loam in the lower part. The substratum to a depth of about 60 inches is brown gravelly sand. In places the slope is less than 12 percent.

Included with this soil in mapping are small areas of Alpena and Menahga soils. Alpena soils have a thin solum over very gravelly sand. They are on the upper parts of ridges. The excessively drained Menahga soils have a substratum that is more acid than that of the Mancelona soil. They are in the lower positions on side slopes. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Mancelona soil and very rapid in the substratum. The available water capacity is low.

Most areas of this soil are used as woodland. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The main concerns in managing woodland are the hazard of water erosion and equipment limitations. The erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing the water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads on the contour help to prevent excessive soil loss. Seeding exposed areas after logging helps to establish a protective vegetative cover. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary. The slope limits the selection of sites for logging roads and landings. Logging roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is poorly suited to corn and small grain because of a severe hazard of water erosion and the low available water capacity. The soil is suited to grass and legumes for hay and pasture. Crop yields are limited by the low available water capacity. Conservation tillage, a conservation cropping system, contour farming, contour stripcropping, diversions, terraces, and grassed waterways help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet causes compaction of the surface layer and poor tilth

and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields, dwellings, and local roads and streets because of the slope. This limitation can be overcome by cutting and filling and by establishing septic tank absorption fields or roads on the contour. Also, the less sloping included or nearby soils can be selected as building sites. The effluent in septic tank absorption fields drains satisfactorily through the soil, but it can pollute ground water because of the very rapid permeability in the substratum.

The land capability classification is IVe. The woodland ordination symbol is 3R. The primary habitat type is AQV, and the secondary habitat type is PMV.

MeB—Manistee loamy sand, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on ridges in glacial lake basins and on outwash plains. Individual areas are irregular in shape and generally range from 10 to 120 acres in size.

Typically, the surface layer is dark brown, very friable loamy sand about 3 inches thick. The subsurface layer is brown, very friable loamy sand about 2 inches thick. The subsoil is about 20 inches of reddish brown and yellowish red, very friable loamy sand. The next 3 inches is reddish brown, friable fine sandy loam and very friable loamy sand. Below this is about 8 inches of reddish brown, firm clay. The substratum to a depth of about 60 inches is reddish brown, firm clay. In places the slope is as much as 10 percent.

Included with this soil in mapping are small areas of Allendale, Hibbing, and Menahga soils. The somewhat poorly drained Allendale soils are in depressions and drainageways. Hibbing and Menahga soils are in landscape positions similar to those of the Manistee soil. Hibbing soils have a thin silty mantle underlain by clayey deposits. Menahga soils are sandy throughout. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the sandy upper part of the profile in the Manistee soil, very slow in the lower part of the subsoil, and slow in the substratum. The available water capacity is low.

Most areas of this soil are used as woodland. The soil is suited to trees. No major concerns affect the management of woodland. The low available water capacity, however, limits the growth of trees, especially hardwoods. Hardwoods do not grow as well as conifers on the more droughty soils.

After trees are cut, plant competition can delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture, but crop yields are limited by the low available water capacity. If irrigated, the soil can produce better and more consistent yields. If the soil is cultivated, water erosion is a slight hazard and soil blowing can occur. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling water erosion and soil blowing. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless irrigation water is applied. Overgrazing depletes the plant cover and results in soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the rapid permeability in the upper part of the profile and the slow permeability in the lower part. If absorption fields are installed in the rapidly permeable sandy upper layers, the effluent can move laterally. This limitation combined with the slow permeability in the lower part of the profile can be overcome by constructing a mound of suitable filtering material. The soil is suited to dwellings without basements and to local roads and streets. It is poorly suited to dwellings with basements because of a high shrink-swell potential in the clayey lower part of the profile. This limitation can be overcome by constructing the basements above the clayey soil layer or by placing a layer of coarse material, such as sand or gravel, under and around the foundations. Installing tile drains around the foundations helps to remove excess water.

The land capability classification is IIIs. The woodland ordination symbol is 3A. The habitat type is AQV.

MhB—Menahga sand, 0 to 6 percent slopes. This deep, nearly level and gently sloping, excessively drained soil is on flats and broad ridges on moraines, outwash plains, and stream terraces. Individual areas are irregular in shape and generally range from 5 to 1,000 acres in size.

Typically, the surface layer is black, very friable sand about 2 inches thick. The subsurface layer is dark grayish brown, very friable sand about 1 inch thick. The subsoil is sand about 22 inches thick. It is dark brown and very friable in the upper part and strong brown and loose in the lower part. The substratum to a depth of about 60 inches is yellowish brown and light yellowish brown sand. In some places the surface layer is loamy sand. In other places the slope is as much as 10 percent.

Included with this soil in mapping are small areas of Au Gres, Croswell, Ishpeming, Menominee, Pence, and Shawano soils. The somewhat poorly drained Au Gres soils and the moderately well drained Croswell soils are in depressions, in drainageways, and on flats along the margins of lakes and reservoirs. Ishpeming soils are underlain by igneous or metamorphic bedrock at a depth of 20 to 40 inches. They are near rock outcrops. Menominee, Pence, and Shawano soils are in landscape positions similar to those of the Menahga soil. Menominee soils are underlain by loamy deposits at a depth of 20 to 40 inches. Pence soils have a loamy mantle 12 to 20 inches thick. They have more gravel in the substratum than the Menahga soil. Shawano soils formed in deposits of sandy material, which is fine sand in size. Included soils make up about 15 percent of the unit.

Permeability is rapid in the Menahga soil. Surface runoff is slow. The available water capacity is low. The surface layer is very friable and can be easily tilled.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. A few areas are irrigated and are used to grow specialty crops, such as potatoes. Some areas that were formerly cropland have been planted to red pine or jack pine or are reverting naturally to woodland.

This soil is suited to trees (fig. 11). The main concern in managing woodland is the seedling mortality resulting from droughtiness. Equipment limitations also are a concern. Planting when the soil is moist can reduce seedling losses. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture, but crop yields are limited by the low available water capacity. Applications of fertilizer and irrigation water improve productivity. The soil is suited to sprinkler irrigation.

Figure 11.—A stand of northern pin oak in an area of Menahga sand, 0 to 6 percent slopes.

Because of the rapid permeability, the irrigation rate should be limited. Limiting the rate helps to prevent the leaching of plant nutrients from the root zone. Water erosion generally is not a problem, but the soil is subject to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field

windbreaks, and wind stripcropping help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling soil blowing. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless irrigation water is applied. Overgrazing depletes the plant cover and results in soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

The soil is suited to dwellings and to local roads and streets. The effluent in septic tank absorption fields drains satisfactorily through the soil, but it can pollute ground water because of the rapid permeability.

The land capability classification is IVs. The woodland ordination symbol is 6S. The primary habitat type is AQV, and the secondary habitat type is PMV.

MhC—Menahga sand, 6 to 15 percent slopes. This deep, sloping and moderately steep, excessively drained soil is on the side slopes of ridges and knobs on moraines, outwash plains, and stream terraces. Individual areas are oblong or irregular in shape and generally range from 5 to 1,000 acres in size.

Typically, the surface layer is very dark grayish brown, very friable sand about 1 inch thick. The subsurface layer is dark grayish brown, very friable sand about 2 inches thick. The subsoil is sand about 17 inches thick. It is dark brown and very friable in the upper part and brown and loose in the lower part. The substratum to a depth of about 60 inches is light brown sand. In some places the surface layer is loamy sand. In other places the slope is as little as 2 percent or as much as 20 percent.

Included with this soil in mapping are small areas of Ishpeming, Pence, and Shawano soils. Ishpeming soils are underlain by igneous or metamorphic bedrock at a depth of 20 to 40 inches. They are near rock outcrops. Pence and Shawano soils are in landscape positions similar to those of the Menahga soil. Pence soils have a loamy mantle 12 to 20 inches thick. They have more gravel in the substratum than the Menahga soil. Shawano soils formed in deposits of sandy material, which is fine sand in size. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Menahga soil. Surface runoff is slow or medium in cultivated areas. The available water capacity is low. The surface layer is very friable and can be easily tilled.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. Some areas that were formerly cropland have been planted to red pine or jack pine or are reverting naturally to woodland.

This soil is suited to trees. The main concern in managing woodland is the seedling mortality resulting from droughtiness. Equipment limitations also are a concern. Planting when the soil is moist can reduce seedling losses. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel.

This soil is generally unsuited to corn and small grain because of the low available water capacity, the hazard of soil blowing, and a moderate hazard of water erosion. It is suited to grasses and legumes for hay and pasture. Crop yields are limited by the low available water capacity. Applications of fertilizer and irrigation water improve productivity. The soil is suited to sprinkler irrigation. Because of the rapid permeability, the irrigation rate should be limited. Limiting the rate helps to prevent the leaching of plant nutrients from the root zone. Water erosion is a moderate hazard on this soil. The soil is subject to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling water erosion and soil blowing. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless irrigation water is applied. Overgrazing depletes the plant cover and results in soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

The effluent in septic tank absorption fields drains satisfactorily through this soil, but it can pollute ground water because of the rapid permeability. The soil is only moderately suited to dwellings and to local roads and streets because of the slope. This limitation can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required.

The land capability classification is VIs. The

woodland ordination symbol is 6S. The primary habitat type is AQV, and the secondary habitat type is PMV.

MhD—Menahga sand, 15 to 25 percent slopes. This deep, moderately steep and steep, excessively drained soil is on the side slopes of ridges on moraines, outwash plains, and stream terraces. Individual areas are long and narrow or irregular in shape and generally range from 10 to 1,000 acres in size.

Typically, the surface layer is very dark grayish brown, very friable sand about 2 inches thick. The subsoil is brown, loose sand about 18 inches thick. The substratum to a depth of about 60 inches is strong brown sand. In some places the surface layer is loamy sand. In other places the slope is as little as 10 percent.

Included with this soil in mapping are small areas of Ishpeming and Pence soils. Ishpeming soils are underlain by igneous or metamorphic bedrock at a depth of 20 to 40 inches. They are near rock outcrops. Pence soils are in landscape positions similar to those of the Menahga soil. They have a loamy mantle 12 to 20 inches thick. Also, they have more gravel in the substratum than the Menahga soil. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Menahga soil. The available water capacity is low.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are the hazard of water erosion, seedling mortality, and equipment limitations. The erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing the water by water bars, outsloping road surfaces, ditches, and culverts and establishing logging roads and trails on the contour help to prevent excessive soil loss. Seeding exposed areas after logging helps to establish a protective vegetative cover. Seedling mortality, which is caused by droughtiness, can be reduced by planting when the soil is moist. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate.

In areas where the slope limits the use of equipment, yarding logs by cable may be necessary. The slope also limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel.

This soil is generally unsuited to cultivated crops and pasture because of the low available water capacity, the hazard of soil blowing, and a severe hazard of water erosion.

This soil is poorly suited to septic tank absorption fields, dwellings, and local roads and streets because of the slope. This limitation can be overcome by cutting and filling. Also, sites in areas of the less sloping included soils can be selected. Local roads and streets can be constructed on the contour. The effluent in septic tank absorption fields drains satisfactorily through the soil, but it can pollute ground water because of the rapid permeability in the substratum.

The land capability classification is VIIs. The woodland ordination symbol is 6R. The primary habitat type is AQV, and the secondary habitat type is PMV.

MmB—Menahga-Mancelona-Menominee complex, 2 to 6 percent slopes. These deep, gently sloping soils are on ridges, primarily on end moraines. The Menahga soil is excessively drained, the Mancelona soil is somewhat excessively drained, and the Menominee soil is well drained. Individual areas are irregular in shape and generally range from 10 to 160 acres in size. They are 30 to 40 percent Menahga sand, 20 to 30 percent Mancelona loamy sand, and 10 to 20 percent Menominee loamy sand. The three soils occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the surface layer of the Menahga soil is very dark brown, very friable sand about 4 inches thick. The subsurface layer is dark brown, very friable loamy sand about 3 inches thick. The subsoil is brown, loose sand about 13 inches thick. The substratum to a depth of about 60 inches is strong brown sand. In some places the surface layer is loamy sand. In other places the slope is as much as 15 percent.

Typically, the surface layer of the Mancelona soil is black, very friable loamy sand about 3 inches thick. The subsoil is about 23 inches thick. It is brown, very friable loamy sand in the upper part and strong brown, friable sandy loam and very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is pale brown gravelly sand. In places the slope is as much as 15 percent.

Typically, the surface layer of the Menominee soil is very dark grayish brown, very friable loamy sand about 6 inches thick. The subsoil is about 39 inches thick. It is strong brown, very friable sand in the upper part; strong brown and brown, very friable loamy sand in the next part; and brown, friable fine sandy loam and strong brown, very friable sandy loam in the lower part. The

substratum to a depth of about 60 inches is brown fine sandy loam. In places the slope is as much as 15 percent.

Included with these soils in mapping are small areas of Au Gres, Emmet, Karlin, Nadeau, and Shawano soils. The somewhat poorly drained Au Gres soils are sandy throughout. They are in depressions and drainageways. Emmet, Karlin, Nadeau, and Shawano soils are in landscape positions similar to those of the Menahga, Mancelona, and Menominee soils. Emmet soils are loamy throughout. Karlin soils are similar to the Menahga soil but are typically loamy fine sand in the upper 20 to 40 inches. Nadeau soils are similar to the Mancelona soil but have a loamy mantle 10 to 25 inches thick. Also, they have more gravel in the lower part of the subsoil and in the substratum than the Mancelona soil. Shawano soils are similar to the Menahga soil but formed in deposits of sandy material, which is fine sand in size. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Menahga soil. It is moderately rapid in the subsoil of the Mancelona soil and very rapid in the substratum. It is rapid in the sandy upper part of the profile in the Menominee soil and moderate in the loamy lower part. The available water capacity is low in the Menahga and Mancelona soils and moderate in the Menominee soil. The root development for most crops is restricted in the Mancelona soil by the droughtiness of the gravelly sand below a depth of 20 to 40 inches.

Most areas of these soils are used as woodland. Some are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. The substratum of the Mancelona soil is a probable source of sand and gravel.

These soils are suited to trees. The main concerns in managing woodland are equipment limitations and seedling mortality on the Menahga and Menominee soils. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and logging roads that are used repeatedly can be stabilized with gravel. Seedling mortality, which is caused by droughtiness, can be reduced by planting when the soil is moist. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation on the Mancelona and Menominee soils.

These soils are suited to corn and small grain, but crop yields are limited by the low available water capacity in the Mancelona and Menahga soils. Applications of fertilizer and irrigation water improve productivity. If the soils are cultivated, water erosion is a slight or moderate hazard and soil blowing can occur. Conservation tillage, a conservation cropping system, winter cover crops, proper management of crop residue, contour stripcropping, wind stripcropping, field windbreaks, and grassed waterways help to prevent excessive soil loss.

These soils are suited to grasses and legumes for pasture and hay, but forage yields are limited by the low or moderate available water capacity. Overgrazing depletes the plant cover and results in water erosion and soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and timely deferment of grazing help to keep the pasture in good condition.

These soils are suited to dwellings and to local roads and streets. The Menominee soil is suited to septic tank absorption fields. The effluent in septic tank absorption fields drains satisfactorily in areas of the Menahga and Mancelona soils, but it can pollute ground water because of the rapid or very rapid permeability.

The land capability classification is IVs. The woodland ordination symbol is 6S for the Menahga soil, 3A for the Mancelona soil, and 5S for the Menominee soil. The primary habitat type is AQVib, and the secondary habitat type is AQV.

MmC—Menahga-Mancelona-Menominee complex, 6 to 15 percent slopes. These deep, sloping and moderately steep soils are on the side slopes of ridges, primarily on end moraines. The Menahga soil is excessively drained, the Mancelona soil is somewhat excessively drained, and the Menominee soil is well drained. Individual areas are irregular in shape and generally range from 10 to 600 acres in size. They are 30 to 35 percent Menahga sand, 25 to 35 percent Mancelona loamy sand, and 15 to 20 percent Menominee loamy sand. The three soils occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the surface layer of the Menahga soil is very dark grayish brown, very friable sand about 3 inches thick. The subsoil is strong brown, loose sand about 17 inches thick. The substratum to a depth of about 60 inches is brown sand. In some places the surface layer is loamy sand. In other places the slope is less than 6 percent.

Typically, the surface layer of the Mancelona soil is black, very friable loamy sand about 3 inches thick. The subsurface layer is brown, very friable loamy sand about 1 inch thick. The subsoil is strong brown and brown, very friable loamy sand about 22 inches thick.

The substratum to a depth of about 60 inches is brown gravelly sand. In places the slope is less than 6 percent.

Typically, the surface layer of the Menominee soil is black, very friable loamy sand about 3 inches thick. The subsurface layer is dark brown, very friable loamy sand about 2 inches thick. The subsoil is about 37 inches thick. It is strong brown, very friable loamy sand in the upper part; yellowish red, friable loamy sand in the next part; and brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is brown sandy loam. In places the slope is less than 6 percent.

Included with these soils in mapping are small areas of Emmet, Karlin, and Nadeau soils. These included soils are in landscape positions similar to those of the Menahga, Mancelona, and Menominee soils. Emmet soils are loamy throughout. Karlin soils are similar to the Menahga soil but are typically loamy fine sand in the upper 20 to 40 inches. Nadeau soils are similar to the Mancelona soil but have a loamy mantle 10 to 25 inches thick. Also, they have more gravel in the lower part of the subsoil and in the substratum than the Mancelona soil. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Menahga soil. It is moderately rapid in the subsoil of the Mancelona soil and very rapid in the substratum. It is rapid in the sandy upper part of the profile in the Menominee soil and moderate in the loamy lower part. The available water capacity is low in the Menahga and Mancelona soils and moderate in the Menominee soil.

Most areas of these soils are used as woodland. The substratum of the Mancelona soil is a probable source of sand and gravel.

These soils are suited to trees. The main concerns in managing woodland are equipment limitations and seedling mortality on the Menahga and Menominee soils. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils. Landings and logging roads that are used repeatedly can be stabilized with gravel. Seedling mortality, which is caused by droughtiness, can be reduced by planting when the soil is moist. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation on the Mancelona and Menominee soils.

These soils are generally unsuited to corn and small grain because of the low available water capacity on the Menahga and Mancelona soils, the hazard of soil blowing, and a moderate hazard of water erosion. Applications of fertilizer and irrigation water improve productivity. If these soils are cultivated, water erosion is a moderate hazard and soil blowing can occur. Conservation tillage, winter cover crops, proper management of crop residue, contour stripcropping, wind stripcropping, field windbreaks, and grassed waterways help to prevent excessive soil loss.

These soils are suited to grasses and legumes for pasture and hay, but forage yields are limited by the low or moderate available water capacity. Overgrazing depletes the plant cover and results in water erosion and soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and timely deferment of grazing help to keep the pasture in good condition.

These soils are only moderately suited to dwellings and to local roads and streets because of the slope. This limitation can be overcome by cutting and filling and by building on the contour. Also, sites in areas of the less sloping included or adjacent soils may be selected. The Menominee soil is only moderately suited to septic tank absorption fields because of the slope. This limitation can be overcome by cutting and filling. Also, sites in areas of the less sloping included soils can be selected. The effluent in septic tank absorption fields drains satisfactorily in areas of the Menahga and Mancelona soils, but it can pollute ground water because of the rapid or very rapid permeability.

The land capability classification is VIs. The woodland ordination symbol is 6S for the Menahga soil, 3A for the Mancelona soil, and 5S for the Menominee soil. The primary habitat type is AQVib, and the secondary habitat type is AQV.

MmD—Menahga-Mancelona-Menominee complex, 15 to 25 percent slopes. These deep, moderately steep and steep soils are on uneven side slopes of ridges, primarily on end moraines. The Menahga soil is excessively drained, the Mancelona soil is somewhat excessively drained, and the Menominee soil is well drained. Individual areas are long and narrow or irregular in shape and generally range from 10 to 1,200 acres in size. They are 35 to 40 percent Menahga sand, 25 to 30 percent Mancelona loamy sand, and 15 to 20 percent Menominee loamy sand. The three soils occur as areas so intricately intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Menahga soil is black, very friable sand about 3 inches thick. The subsurface layer is brown, very friable sand about 2 inches thick. The subsoil is strong brown, loose sand

about 21 inches thick. The substratum to a depth of about 60 inches is strong brown sand. In places the slope is less than 15 percent.

Typically, the surface layer of the Mancelona soil is black, very friable loamy sand about 2 inches thick. The subsurface layer is brown, very friable loamy sand about 1 inch thick. The subsoil is about 37 inches thick. It is strong brown, very friable loamy sand in the upper part; brown, friable loamy sand in the next part; and reddish brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is brown gravelly sand. In places the slope is less than 15 percent.

Typically, the surface layer of the Menominee soil is very dark grayish brown, very friable loamy sand about 3 inches thick. The subsurface layer is dark grayish brown, very friable loamy sand about 2 inches thick. The subsoil is about 40 inches thick. It is dark brown, very friable loamy sand and sand in the upper part; brown, friable fine sandy loam in the next part; and dark brown, friable loam and sandy loam in the lower part. The substratum to a depth of about 60 inches is brown sandy loam. In places the slope is less than 15 percent.

Included with these soils in mapping are small areas of Emmet and Nadeau soils. These included soils are in landscape positions similar to those of the Menahga, Mancelona, and Menominee soils. Emmet soils are loamy throughout. Nadeau soils are similar to the Mancelona soil but have a loamy mantle 10 to 25 inches thick. Also, they have more gravel in the lower part of the subsoil and in the substratum than the Mancelona soil. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Menahga soil. It is moderately rapid in the subsoil of the Mancelona soil and very rapid in the substratum. It is rapid in the sandy upper part of the profile in the Menominee soil and moderate in the loamy lower part. The available water capacity is low in the Menahga and Mancelona soils and moderate in the Menominee soil.

Most areas of these soils are used as woodland. The substratum of the Mancelona soil is a probable source of sand and gravel.

These soils are used as woodland. The main concerns in managing woodland are the hazard of water erosion and equipment limitations. Seedling mortality is a concern on the Menahga and Menominee soils. The erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing the water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads on the contour help to prevent excessive soil loss. Seeding exposed areas after logging helps to establish a protective vegetative cover. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary. The slope limits the selection of sites for logging roads and landings. Logging roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils. Landings and logging roads that are subject to the repeated use of heavy equipment can be stabilized with gravel. Seedling mortality, which is caused by droughtiness, can be reduced by planting when the soil is moist. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation on the Mancelona and Menominee soils.

These soils are generally unsuited to cultivated crops and pasture because of the low available water capacity in the Menahga and Mancelona soils, a severe hazard of water erosion, and the hazard of soil blowing.

These soils are poorly suited to septic tank absorption fields, dwellings, and local roads and streets because of the slope. This limitation can be overcome by cutting and filling and by establishing septic tank absorption fields or roads on the contour. The effluent in septic tank absorption fields drains satisfactorily in areas of the Menahga and Mancelona soils, but it can pollute ground water because of the rapid or very rapid permeability in the substratum.

The land capability classification is VIIs. The woodland ordination symbol is 6R for the Menahga soil, 3R for the Mancelona soil, and 5R for the Menominee soil. The primary habitat type is AQVib, and the secondary habitat type is AQV.

MoB—Menominee loamy sand, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on ridgetops on outwash plains and moraines. Individual areas are irregular in shape and generally range from 3 to 240 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loamy sand about 8 inches thick. The subsoil is about 22 inches of brown and strong brown, very friable sand. The next 6 inches is brown, friable loamy sand. Below this is about 14 inches of brown and strong brown, friable fine sandy loam. The

substratum to a depth of about 60 inches is brown fine sandy loam. In places the slope is less than 2 percent or as much as 10 percent.

Included with this soil in mapping are small areas of Emmet, Iosco, Menahga, and Shawano soils. Emmet, Menahga, and Shawano soils are in landscape positions similar to those of the Menominee soil. Emmet soils are loamy throughout. Menahga and Shawano soils are sandy throughout. The somewhat poorly drained Iosco soils are in depressions and drainageways. Included soils make up 2 to 15 percent of the unit.

Permeability is rapid in the sandy upper part of the profile in the Menominee soil and moderate in the loamy lower part. Surface runoff is slow in cultivated areas. The available water capacity is moderate. The surface layer is very friable and can be easily tilled.

Areas of this soil are used as woodland, cropland, or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations and seedling mortality. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and logging roads that are subject to the repeated use of heavy equipment can be stabilized with gravel. Seedling mortality, which is caused by droughtiness, can be reduced by planting when the soil is moist. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate. If trees are planted, site preparation by mechanical or chemical means may be needed to control competing vegetation.

This soil is suited to corn and small grain and to legumes and grasses for hay and pasture. If irrigated, it can produce better and more consistent yields. It is suited to sprinkler irrigation. If the soil is cultivated, water erosion is a slight or moderate hazard and soil blowing can occur. Conservation tillage, a conservation cropping system, winter cover crops, proper management of crop residue, field windbreaks, wind stripcropping, and grassed waterways help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling water erosion and soil blowing. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless irrigation water is applied. Overgrazing depletes the plant cover and results in soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is suited to septic tank absorption fields, dwellings, and local roads and streets.

The land capability classification is IIIe. The woodland ordination symbol is 5S. The primary habitat type is AQVib, and the secondary habitat type is ATM.

MoC—Menominee loamy sand, 6 to 12 percent slopes. This deep, sloping, well drained soil is on ridgetops and uneven side slopes of ridges on outwash plains and moraines. Individual areas are irregular in shape and generally range from 3 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loamy sand about 3 inches thick. The subsurface layer is dark grayish brown, very friable loamy sand about 2 inches thick. The subsoil is about 40 inches thick. It is brown, very friable loamy sand and sand in the upper part; brown, friable fine sandy loam in the next part; and brown, friable loam and sandy loam in the lower part. The substratum to a depth of about 60 inches is brown sandy loam. In places the slope is less than 6 percent or as much as 18 percent.

Included with this soil in mapping are small areas of Emmet, Mancelona, Menahga, and Shawano soils. Emmet soils are loamy throughout. They are in landscape positions similar to those of the Menominee soil. Mancelona soils are typically sandy throughout. They are in the higher positions on side slopes. Menahgaand Shawano soils are sandy throughout. They are generally in the lower positions on side slopes. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the sandy upper part of the profile in the Menominee soil and moderate in the loamy lower part. Surface runoff is medium in cultivated areas. The available water capacity is moderate.

Most areas of this soil are used as woodland. Some are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations and seedling mortality. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and logging roads that are subject to the repeated use of heavy equipment can be stabilized with gravel. The slope limits the selection of landing sites. Landings can be established on the nearly level and gently sloping included or adjacent soils. Seedling mortality, which is caused by droughtiness, can be reduced by planting when the soil is moist. Planting containerized seedlings or vigorous nursery stock also

can reduce the seedling mortality rate. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is poorly suited to corn and small grain because of a moderate hazard of water erosion. It is suited to legumes and grasses for hay and pasture. If irrigated, the soil can produce better and more consistent yields. It is suited to sprinkler irrigation. If the soil is cultivated, soil blowing can also occur. Conservation tillage, a conservation cropping system, winter cover crops, proper management of crop residue, field windbreaks, wind stripcropping, and grassed waterways help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling water erosion and soil blowing. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless irrigation water is applied. Overgrazing depletes the plant cover and results in water erosion and soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is only moderately suited to septic tank absorption fields, dwellings, and local roads and streets because of the slope. This limitation can be overcome by cutting and filling. Constructing roads on the contour also helps to overcome the slope.

The land capability classification is IVe. The woodland ordination symbol is 5S. The primary habitat type is AQVib, and the secondary habitat type is ATM.

MoD—Menominee loamy sand, 12 to 20 percent slopes. This deep, moderately steep, well drained soil is on the side slopes of ridges on outwash plains and moraines. Individual areas are irregular in shape and generally range from 5 to 80 acres in size.

Typically, the surface layer is black, very friable loamy sand about 2 inches thick. The subsoil is about 35 inches thick. It is brown and strong brown, very friable sand in the upper part and reddish brown, friable sandy loam and loam in the lower part. The substratum to a depth of about 60 inches is reddish brown sandy loam. In some places the surface layer is sandy loam. In other places the slope is as little as 8 percent.

Included with this soil in mapping are small areas of Emmet, Mancelona, and Shawano soils. Emmet soils are loamy throughout. They generally are in the higher positions on side slopes. Mancelona soils are in landscape positions similar to those of the Menominee soil. They are typically sandy throughout. Shawano soils also are sandy throughout. They generally are in the lower positions on side slopes. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the sandy upper part of the profile in the Menominee soil and moderate in the loamy lower part. Surface runoff is rapid in cultivated areas. The available water capacity is moderate.

Most areas of this soil are used as woodland. The soil is suited to trees. The main concerns in managing woodland are the hazard of water erosion, seedling mortality, and equipment limitations. The erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing the water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads and trails on the contour help to prevent excessive soil loss. Seeding exposed areas after logging helps to establish a protective vegetative cover. Seedling mortality, which is caused by droughtiness, can be minimized by planting when the soil is moist. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate.

In areas where the slope limits the use of equipment, yarding logs by cable may be necessary. The slope also limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is generally unsuited to cultivated crops because of a severe hazard of water erosion and soil blowing. It is suited to legumes and grasses for hay and pasture.

A cover of pasture plants or hay is effective in controlling water erosion and soil blowing. Overgrazing, however, depletes the plant cover. Controlled grazing helps to maintain the plant cover.

This soil is poorly suited to septic tank absorption fields, dwellings, and local roads and streets because of the slope. This limitation can be overcome by cutting and filling and by establishing septic tank absorption fields and roads on the contour. Also, areas of the less sloping included soils can be selected as building sites.

The land capability classification is VIe. The woodland ordination symbol is 5R. The primary habitat type is AQVib, and the secondary habitat type is ATM.

MrC—Michigamme-Rock outcrop complex, 4 to 15 percent slopes. This map unit consists of areas of the moderately deep, gently sloping to moderately steep, well drained Michigamme soil and igneous bedrock outcrops. The Michigamme soil is on ridges and the side slopes of ridges on moraines and outwash plains. Individual areas are mainly irregular in shape and generally range from 5 to several thousand acres in size. They are 50 to 80 percent Michigamme fine sandy loam and 15 to 35 percent Rock outcrop. The Michigamme soil and Rock outcrop occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the surface layer of the Michigamme soil is black, very friable fine sandy loam about 2 inches thick. The subsurface layer is reddish gray, very friable fine sandy loam about 2 inches thick. The subsoil is very friable fine sandy loam about 20 inches thick. It is dark reddish brown in the upper part, reddish brown in the next part, and brown in the lower part. Granite bedrock is at a depth of about 24 inches.

Typically, the Rock outcrop is exposed granite bedrock. In places it is metamorphic bedrock. Some rock outcrops are escarpments that have a vertical face of as much as 100 feet.

Included with this unit in mapping are small areas of Emmet, Padus, and Pence soils. These soils are in landscape positions similar to those of the Michigamme soil. Emmet soils are loamy throughout and are not underlain by granite within a depth of 60 inches. Padus and Pence soils are underlain by sand or by sand and gravel. Also included are small areas of wetter soils in depressions and drainageways. Included soils make up 1 to 15 percent of the unit.

Permeability is moderate in the Michigamme soil. The available water capacity is low. The root development for most crops is restricted by the granite bedrock at a depth of 20 to 40 inches.

Areas of this unit are used as woodland. The Michigamme soil is suited to trees. Trees of commercial quality do not grow in areas of rock outcrops. The main concerns in managing woodland are equipment limitations. The bedrock escarpments severely restrict the movement of logging equipment. Logging roads should be carefully located so that the hazardous escarpments are avoided. The use of equipment is also restricted in spring and in other excessively wet periods because of low strength in the Michigamme soil. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

The Michigamme soil is unsuitable as cropland and pasture because of the low available water capacity and because tillage is hindered by the many outcrops of igneous or metamorphic rock.

The Michigamme soil is poorly suited to septic tank absorption fields because of the moderate depth to bedrock and possible pollution of ground water by effluent flowing through crevices in the bedrock. These limitations can be overcome by mounding the site with suitable filtering material. Also, in some areas the effluent can be pumped to an absorption field on a better suited site. The Michigamme soil is poorly suited to dwellings with basements because of the moderate depth to hard bedrock. This limitation can be overcome by adding fill material, which can raise the site, or by constructing the dwellings with only partially exposed basements. The soil is only moderately suited to dwellings without basements because of the slope and the moderate depth to hard bedrock. These limitations can be overcome by leveling or by adding coarse fill material to form a level base deep enough for footings. The soil is only moderately suited to local roads and streets because of the depth to bedrock, the slope, and a moderate potential for frost action. These limitations can be overcome by cutting and filling. The underlying hard bedrock, however, limits the depth of cuts. Roads can also be constructed on the contour or on the less sloping areas. Straight roads may not be possible because of the rock outcrops.

The land capability classification is VIIs. The woodland ordination symbol is 3L for the Michigamme soil. The primary habitat type is ATM, and the secondary habitat type is AQVib.

MsA—Monico fine sandy loam, 0 to 3 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is in depressions and drainageways on ground moraines. Individual areas are irregular in shape and generally range from 5 to 80 acres in size.

Typically, about 2 inches of black, partially decomposed forest litter is at the surface. The subsurface layer is pinkish gray, friable fine sandy loam about 5 inches thick. The subsoil is about 28 inches thick. It is dark reddish brown and reddish brown, mottled, friable fine sandy loam in the upper part and

brown, mottled, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled sandy loam.

Included with this soil in mapping are small areas of Ensley and Sarona soils. The poorly drained and very poorly drained Ensley soils are in the lower areas. The well drained Sarona soils are on the slightly higher ridges. Included soils make up 2 to 15 percent of the unit.

Permeability is moderate in the Monico soil. The available water capacity is moderate. Unless the soil is drained, the root development for most crops is restricted by a seasonal high water table at a depth of 1 to 3 feet.

Most areas of this soil are used as woodland. A few are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations and the windthrow hazard. The use of equipment is restricted in spring, in late fall, and in other excessively wet periods by the perched seasonal high water table and by low strength. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for all-weather logging roads, a gravel base is needed. Culverts are needed to maintain the natural drainage system. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment. Also, they can be established on the better suited adjacent soils. A shallow rooting depth, which is caused by the high water table, can result in windthrow of many trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

If drained, this soil is suited to corn and small grain and to legumes and grasses for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains can improve internal drainage. Ditchbanks are easily eroded unless they are protected by a vegetative cover. Proper management of crop residue and additions of other organic material improve tilth and fertility and increase the organic matter content and the rate of water infiltration.

If drained, this soil is suited to pasture and hay. Overgrazing depletes the plant cover and increases the extent of undesirable plant species. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and reduces the rate of water infiltration. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields and dwellings because of the seasonal high water table. In areas where it is below a depth of 2 feet, the seasonal high water table can be overcome by constructing a mound of suitable filtering material. On building sites it can be overcome by constructing dwellings without basements, building on fill material, or constructing the basements above the level of wetness. The wetness also can be overcome by installing tile drains around the foundations and providing gravity outlets or other dependable outlets. Installing a drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or gravel, help to prevent the damage to local roads and streets caused by a high potential for frost action.

The land capability classification is IIw. The woodland ordination symbol is 3W. The habitat type is TMC.

Mt—Moquah fine sandy loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on flood plains. It is subject to occasional flooding. Individual areas are elongated and generally range from 5 to 80 acres in size.

Typically, the surface layer is very dark grayish brown, very friable fine sandy loam about 12 inches thick. The upper part of the substratum is dark reddish brown very fine sandy loam. The next part is reddish brown fine sandy loam. The lower part to a depth of about 60 inches is reddish brown and brown, mottled, stratified very fine sand and fine sand.

Included with this soil in mapping are small areas of Arnheim, Charlevoix, Gaastra, and Wainola soils. The poorly drained Arnheim soils are in the lower areas on flood plains. Charlevoix, Gaastra, and Wainola soils are somewhat poorly drained. They are in depressions and drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow or moderate in the Moquah soil. The available water capacity is moderate. The depth to a water table is as little as 3 feet during wet seasons.

Most areas of this soil are used as woodland. Some

have been cleared and are used as unimproved pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted by flooding. In spring and in other excessively wet periods, low strength also restricts the use of equipment. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick.

After trees are cut, plant competition can delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control plant competition. Subsequent invading species should be controlled.

If protected from flooding, this soil is suited to corn and small grain and to legumes and grasses for hay and pasture. Proper management of crop residue and additions of other organic material improve tilth and fertility and increase the organic matter content and the rate of water infiltration.

This soil is suited to most forage species. Overgrazing depletes the plant cover and increases the extent of undesirable plant species. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and reduces the rate of water infiltration. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields, dwellings, and local roads and streets because of the occasional flooding. Overcoming this hazard is difficult. A more suitable site should be selected.

The land capability classification is IIIw. The woodland ordination symbol is 3L. The habitat type is ATM.

NaB—Nadeau fine sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on ridgetops on outwash plains, moraines, and eskers. Individual areas are irregular in shape and generally range from 3 to 240 acres in size.

Typically, the surface layer is very dark gray, very friable fine sandy loam about 1 inch thick. The subsurface layer is brown, very friable fine sandy loam about 1 inch thick. The subsoil is about 25 inches thick. It is brown, very friable fine sandy loam in the upper part; reddish brown, friable very gravelly sandy loam in the next part; and brown, very friable very gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is pale brown very gravelly sand. In places the slope is as much as 10 percent.

Included with this soil in mapping are small areas of Banat and Mancelona soils. The somewhat poorly drained Banat soils are in depressions and drainageways. The somewhat excessively drained Mancelona soils are in landscape positions similar to those of the Nadeau soil. They are typically sandy throughout. Also, they have less gravel in the lower part of the subsoil and in the substratum than the Nadeau soil. Included soils make up 6 to 15 percent of the unit.

Permeability is moderate in the subsoil of the Nadeau soil and very rapid in the substratum. Surface runoff is slow in cultivated areas. The available water capacity is low. The surface layer is very friable and can be easily tilled. The root development for most crops is restricted by the droughtiness of the underlying gravelly sand.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is suited to corn and small grain, but crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a slight or moderate hazard. Soil blowing is also a hazard. Conservation tillage, a conservation cropping system, winter cover crops, proper management of crop residue, contour stripcropping, field windbreaks, and grassed waterways help to prevent excessive soil loss.

This soil is suited to grasses and legumes for pasture and hay, but forage yields are limited by the low available water capacity. Overgrazing depletes the plant cover and results in water erosion. Proper stocking

rates, pasture renovation, rotation grazing, and timely deferment of grazing help to keep the pasture in good condition.

The effluent in septic tank absorption fields drains satisfactorily through this soil, but it can pollute ground water because of the very rapid permeability in the substratum. This limitation can be overcome by mounding with suitable filtering material. The soil is only moderately suited to dwellings and to local roads and streets because of large stones in the soil. A moderate potential for frost action is also a concern on sites for local roads and streets. Stones can be removed during construction by mechanical means. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is IIIs. The woodland ordination symbol is 2L. The primary habitat type is AQVib, and the secondary habitat type is ATM.

NaC—Nadeau fine sandy loam, 6 to 12 percent slopes. This deep, sloping, well drained soil is on the side slopes of ridges and knobs on outwash plains, moraines, and eskers. Individual areas are elongated or irregular in shape and generally range from 5 to 200 acres in size.

Typically, the surface layer is very dark grayish brown, very friable fine sandy loam about 3 inches thick. The subsurface layer is dark grayish brown, very friable fine sandy loam about 2 inches thick. The subsoil is about 11 inches thick. It is brown, friable sandy loam in the upper part and reddish brown, friable very gravelly loam in the lower part. The substratum to a depth of about 60 inches is brown very gravelly sand. In some places the surface layer is loam. In other places the slope is as little as 3 percent or as much as 15 percent.

Included with this soil in mapping are small areas of Alpena and Mancelona soils. These soils are in landscape positions similar to those of the Nadeau soil. Alpena soils are excessively drained and have a thin solum over very gravelly sand. Mancelona soils are somewhat excessively drained. They are typically sandy throughout. Also, they have less gravel in the lower part of the subsoil and in the substratum than the Nadeau soil. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the subsoil of the Nadeau soil and very rapid in the substratum. Surface runoff is medium in cultivated areas. The available water capacity is low. The root development for most crops is restricted by the droughtiness of the underlying very gravelly sand.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is poorly suited to corn and small grain because of a severe hazard of water erosion. Crop yields are limited by the low available water capacity. If cultivated crops are grown, soil blowing is a hazard. Conservation tillage, a conservation cropping system, winter cover crops, proper management of crop residue, contour stripcropping, field windbreaks, and grassed waterways help to prevent excessive soil loss.

This soil is suited to grasses and legumes for pasture and hay, but forage yields are limited by the low available water capacity. Overgrazing depletes the plant cover and results in water erosion. Proper stocking rates, pasture renovation, rotation grazing, and timely deferment of grazing help to keep the pasture in good condition.

The effluent in septic tank absorption fields drains satisfactorily through this soil, but it can pollute ground water because of the very rapid permeability in the substratum. This limitation can be overcome by mounding with suitable filtering material. The soil is only moderately suited to dwellings and to local roads and streets because of the slope and because of large stones in the soil. A moderate potential of frost action is also a concern on sites for local roads and streets. The slope can be overcome by cutting and filling. Constructing roads on the contour also helps to overcome the slope. Stones can be removed during construction by mechanical means. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is IVe. The

woodland ordination symbol is 2L. The primary habitat type is AQVib, and the secondary habitat type is ATM.

Nh—Nahma muck, 0 to 2 percent slopes. This moderately deep, nearly level, very poorly drained soil is in depressions and drainageways on ground moraines. It is subject to ponding. Individual areas are elongated and generally range from 5 to 80 acres in size.

Typically, the surface layer is black, friable muck about 9 inches thick. The subsoil is about 12 inches thick. It is dark gray, mottled, very friable loam in the upper part; brown, mottled, friable loam in the next part; and multicolored, friable sandy loam in the lower part. The substratum is multicolored fine sandy loam about 19 inches thick. Dolomite bedrock is at a depth of about 40 inches.

Included with this soil in mapping are small areas of Bonduel and Ensley soils. The somewhat poorly drained Bonduel soils are in higher landscape positions than those of the Nahma soil. Ensley soils are in landscape positions similar to those of the Nahma soil. They do not have dolomite within a depth of 60 inches. Included soils make up 1 to 15 percent of the unit.

Permeability is moderate in the Nahma soil. The available water capacity is low. The root development for most crops is restricted by a high water table at or above the surface or within a depth of 1 foot most of the year.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The soil is usually wet most of the year. Ruts form easily when wheeled skidders are used during wet periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. All-weather roads require a gravel base. Culverts are needed to maintain the natural drainage system. Wetness, low strength, and the moderate depth to dolomite bedrock are severe limitations on landing sites. The better suited adjacent soils may be needed as sites for landings. Trees generally are not planted on this soil because of the excessive wetness. Reforestation is limited to natural regeneration or hand planting. Seedling mortality, which is caused by wetness, can be minimized by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

Unless drained, this soil is unsuited to cultivated crops. If drained, however, it is suited to corn and small grain and to grasses and legumes for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains are restricted by the depth to dolomite. Also, many areas do not have suitable outlets. Diversions on the adjacent upland soils protect this soil against overflow.

If drained, this soil is suited to pasture and hay. Overgrazing depletes the plant cover and increases the extent of undesirable plant species. A drainage system, proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields because of the seasonal high water table, the ponding, a thin layer of suitable soil material, and possible seepage of effluent. Overcoming these limitations is difficult. A better suited site should be selected. The soil is also generally unsuited to dwellings because of the ponding and to dwellings with basements because of the moderate depth to dolomite. These limitations are difficult to overcome. A better suited site should be selected. The soil is poorly suited to local roads and streets because of the ponding and a high potential for frost action. These hazards can be overcome by constructing the roads and streets on raised, well compacted fill material. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is Vw, undrained. The woodland ordination symbol is 4W. A habitat type has not been assigned.

PaB—Padus fine sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is on flats and ridgetops on outwash plains, stream terraces, kames, and moraines. Individual areas are irregular in shape and generally range from 10 to 360 acres in size.

Typically, the surface layer is black, very friable fine sandy loam about 1 inch thick. The subsurface layer is brown, very friable fine sandy loam about 4 inches

thick. The subsoil is about 8 inches of brown, very friable fine sandy loam. The next 7 inches is brown, very friable fine sandy loam. Below this is about 7 inches of reddish brown, very friable sandy loam and loamy sand. The substratum extends to a depth of about 60 inches. It is strong brown sand in the upper part and reddish brown, stratified sand and gravelly sand in the lower part. In some places the surface layer is loam. In other places the slope is as much as 10 percent. In some areas the subsoil extends to a depth of 40 to 50 inches.

Included with this soil in mapping are small areas of Pence and Sayner soils. These soils are in landscape positions similar to those of the Padus soil. Pence soils have a loamy mantle that is 12 to 20 inches thick. The excessively drained Sayner soils are sandy in the surface layer and in the upper part of the subsoil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the profile in the Padus soil and rapid or very rapid in the lower part. Surface runoff is slow in cultivated areas. The available water capacity is moderate. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content. The root development for most crops is restricted by the droughtiness of the sand and gravelly sand below a depth of 20 to 35 inches.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. Some areas that were formerly cropland have been planted to red pine or are reverting naturally to woodland. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, water erosion is a slight or moderate hazard. It can be controlled by conservation tillage, a conservation cropping system, proper management of crop residue, contour farming, contour stripcropping, and grassed waterways. Regular additions of organic material help to maintain fertility and tilth and increase the rate of water infiltration.

A cover of pasture plants or hay helps to control water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet results in compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to dwellings. The effluent in septic tank absorption fields drains satisfactorily through the soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum. The soil is only moderately suited to local roads and streets because of a moderate potential for frost action. Covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 3L. The primary habitat type is ATD, and the secondary habitat type is ATM.

PaC—Padus fine sandy loam, 6 to 15 percent slopes. This deep, sloping and moderately steep, well drained soil is on ridgetops and the side slopes of ridges on outwash plains, stream terraces, kames, and moraines. Individual areas are oblong or irregular in shape and generally range from 5 to 120 acres in size.

Typically, the surface layer is black, very friable fine sandy loam about 1 inch thick. The subsurface layer is brown, friable fine sandy loam about 1 inch thick. The subsoil is about 38 inches thick. It is brown, very friable fine sandy loam and sandy loam in the upper part and dark yellowish brown, very friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown gravelly sand. In some places the surface layer is loam. In other places the slope is as little as 3 percent or as much as 20 percent. In some areas the subsoil extends to a depth of 40 to 50 inches.

Included with this soil in mapping are small areas of Menahga, Pence, and Sayner soils. These soils are in landscape positions similar to those of the Padus soil. Menahga soils are sandy throughout. Pence soils have a loamy mantle that is 12 to 20 inches thick. Sayner soils are sandy in the surface layer and in the upper part of the subsoil. Included soils make up 8 to 15 percent of the unit.

Permeability is moderate in the upper part of the profile in the Padus soil and rapid or very rapid in the

lower part. Surface runoff is medium in cultivated areas. The available water capacity is moderate. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content. The root development for most crops is restricted by the droughtiness of the sand and gravelly sand below a depth of 20 to 35 inches.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, water erosion is a moderate hazard. It can be controlled by conservation tillage, a conservation cropping system, proper management of crop residue, contour farming, contour stripcropping, and grassed waterways. Regular additions of organic material help to maintain fertility and tilth and increase the rate of water infiltration.

A cover of pasture plants or hay helps to control water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet results in compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is only moderately suited to dwellings because of the slope. Cutting and filling can overcome this limitation. Also, the less sloping areas can be selected as building sites. The effluent in septic tank absorption fields drains satisfactorily through the soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum. The soil is only moderately suited to local roads and streets because of the slope and a moderate potential for frost action. Cutting and filling or constructing the roads on the contour helps to overcome the slope. Covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3L. The primary habitat type is ATD, and the secondary habitat type is ATM.

PaD—Padus fine sandy loam, 15 to 25 percent slopes. This deep, moderately steep and steep, well drained soil is on uneven side slopes of ridges on outwash plains, stream terraces, kames, and moraines. Individual areas are long and narrow or irregular in shape and generally range from 10 to 400 acres in size.

Typically, the surface layer is very dark grayish brown, very friable fine sandy loam about 2 inches thick. The subsurface layer is brown, very friable fine sandy loam about 2 inches thick. The subsoil is very friable sandy loam about 23 inches thick. It is brown in the upper part and reddish brown in the lower part. The substratum to a depth of about 60 inches is reddish brown gravelly sand. In some places the surface layer is loam. In other places the slope is as little as 8 percent.

Included with this soil in mapping are small areas of Menahga and Pence soils. Menahga soils are sandy throughout. They are in the lower positions on side slopes. Pence soils have a loamy mantle that is 12 to 20 inches thick. They are on the upper parts of side slopes. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the upper part of the profile in the Padus soil and rapid or very rapid in the lower part. The available water capacity is moderate.

Most areas of this soil are used as woodland. A few small areas have been cleared and are used as pasture. The substratum is a probable source of sand and gravel.

This soil is suited to trees. Because of the slope, the main concerns in managing woodland are the hazard of water erosion and equipment limitations. The erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing the water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads on the contour minimize erosion. Seeding exposed areas after logging helps to establish a protective vegetative cover. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form if wheeled skidders are used when the soil is wet. Deep

ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary. The slope also limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil generally is unsuited to cultivated crops because of a severe hazard of water erosion. It is suited to grasses and legumes for hay and pasture. A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, depletes the plant cover. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields and to dwellings because of the slope. This limitation is difficult to overcome. A more suitable site should be selected. If the soil is used as a site for septic tank absorption fields, the poor filtering capacity can result in the pollution of ground water. The soil is poorly suited to local roads and streets because of the slope. Cutting and filling or constructing the roads and streets on the contour helps to overcome this limitation.

The land capability classification is VIe. The woodland ordination symbol is 3R. The primary habitat type is ATD, and the secondary habitat type is ATM.

PkB—Pence sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is on flats and ridgetops on outwash plains, stream terraces, and moraines. Individual areas are irregular in shape and generally range from 5 to 640 acres in size.

Typically, the surface layer is black, very friable sandy loam about 1 inch thick. The subsurface layer is dark brown, very friable sandy loam about 1 inch thick. The subsoil is about 19 inches thick. It is dark reddish brown and reddish brown, very friable sandy loam in the upper part and strong brown, very friable gravelly sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown gravelly sand. In places the slope is as much as 10 percent.

Included with this soil in mapping are small areas of Menahga and Padus soils. These soils are in landscape positions similar to those of the Pence soil. The excessively drained Menahga soils are sandy throughout. Padus soils have a loamy mantle that is 20 to 35 inches thick. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the profile in the Pence soil and rapid or very rapid in the lower part. Surface runoff is slow in cultivated areas. The available water capacity is low. The root development for most crops is restricted by the droughtiness of the gravelly sand below a depth of 12 to 20 inches.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. Some areas that were formerly cropland have been planted to red pine or are reverting naturally to woodland. The substratum is a probable source of sand and gravel.

This soil is suited to trees. No major concerns affect the management of woodland. The low available water capacity, however, limits the growth of trees, especially hardwoods. Hardwoods do not grow as well as conifers on the more droughty soils.

This soil is suited to corn and small grain, but crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion and soil blowing are hazards. Conservation tillage, a conservation cropping system, winter cover crops, proper management of crop residue, contour stripcropping, field windbreaks, and grassed waterways help to prevent excessive soil loss.

This soil is suited to grasses and legumes for pasture and hay, but forage yields are limited by the low available water capacity. Overgrazing depletes the plant cover and results in water erosion and soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to dwellings and to local roads and streets. The effluent in septic tank absorption fields drains satisfactorily through the soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum.

The land capability classification is IIIe. The woodland ordination symbol is 3A. The primary habitat type is ATM, and the secondary habitat type is PMV.

PkC—Pence sandy loam, 6 to 15 percent slopes. This deep, sloping and moderately steep, well drained soil is on the side slopes of ridges on outwash plains,

stream terraces, and moraines. Individual areas are irregular in shape and generally range from 10 to 240 acres in size.

Typically, the surface layer is very dark gray, very friable sandy loam about 4 inches thick. The subsoil is very friable sandy loam about 16 inches thick. It is strong brown in the upper part, yellowish red in the next part, and reddish brown in the lower part. The substratum to a depth of about 60 inches is yellowish red gravelly sand. In places the slope is as little as 2 percent.

Included with this soil in mapping are small areas of the excessively drained Menahga soils. Menahga soils are sandy throughout. They are in the lower areas on side slopes. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the profile in the Pence soil and rapid or very rapid in the lower part. Surface runoff is medium in cultivated areas. The available water capacity is low. The root development for most crops is restricted by the droughtiness of the gravelly sand below a depth of 12 to 20 inches.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. Some areas that were formerly cropland have been planted to red pine or are reverting naturally to woodland. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The main concern in managing woodland is the slope, which limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils.

This soil is poorly suited to corn and small grain because of a moderate hazard of water erosion and the low available water capacity, which limits crop yields. If cultivated crops are grown, water erosion and soil blowing are hazards. Conservation tillage, a conservation cropping system, winter cover crops, proper management of crop residue, contour stripcropping, field windbreaks, and grassed waterways help to prevent excessive soil loss.

This soil is suited to grasses and legumes for pasture and hay, but forage yields are limited by the low available water capacity. Overgrazing depletes the plant cover and results in water erosion. Proper stocking rates, pasture renovation, rotation grazing, and timely deferment of grazing help to keep the pasture in good condition.

This soil is only moderately suited to dwellings and to local roads and streets because of the slope. This limitation can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required. The effluent in septic tank absorption fields drains satisfactorily through the soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum.

The land capability classification is IVe. The woodland ordination symbol is 3A. The primary habitat type is ATM, and the secondary habitat type is PMV.

Pm—Pickford mucky silty clay loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained soil is in depressions and drainageways in glacial lake basins and on moraines. It is subject to ponding. Individual areas are long and narrow or irregular in shape and generally range from 10 to 100 acres in size.

Typically, the surface layer is very dark gray, firm mucky silty clay loam about 6 inches thick. The subsurface layer is dark gray, firm silty clay loam about 6 inches thick. The subsoil is dark reddish gray, mottled, firm silty clay loam about 8 inches thick. The substratum to a depth of about 60 inches is weak red, mottled silty clay.

Included with this soil in mapping are small areas of Hibbing, Pinconning, and Selkirk soils. The well drained Hibbing soils are on small ridges. The poorly drained and very poorly drained Pinconning soils are in landscape positions similar to those of the Pickford soil. They are sandy in the upper 20 to 40 inches. The somewhat poorly drained Selkirk soils are in the slightly higher landscape positions. Included soils make up 10 to 15 percent of the unit.

Permeability is very slow in the Pickford soil. The available water capacity is moderate. The root development for most crops is restricted most of the year by a high water table at or above the surface or within a depth of 1 foot.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The soil is usually wet most of the year. Ruts form easily when wheeled skidders are used during the wet periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. All-weather roads require a gravel base. Culverts are needed to maintain the natural drainage system. The wetness and low strength are severe limitations on landing sites. The better suited adjacent soils may be needed as sites for landings. Trees generally are not planted on this soil because of the excessive wetness. Reforestation is limited to natural regeneration or hand

planting. Seedling mortality, which is caused by wetness, can be minimized by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

Unless drained, this soil is unsuited to cultivated crops. If drained, however, it is suited to corn and small grain and to legumes and grasses for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains can improve internal drainage, but some areas do not have suitable outlets. Diversions on the adjacent upland soils protect this soil against overflow.

If drained, this soil is suited to pasture and hay. Overgrazing depletes the plant cover and increases the extent of undesirable plant species. A drainage system, proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields because of the ponding and the very slow permeability. It is also generally unsuited to dwellings because of the ponding. The ponding is difficult to overcome. A better suited site should be selected. The soil is poorly suited to local roads and streets because of the ponding and low strength. These limitations can be overcome by constructing the roads and streets on raised, well compacted fill material. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is Vw, undrained. The woodland ordination symbol is 6W. A habitat type has not been assigned.

Pn—Pinconning loamy sand, 0 to 2 percent slopes. This deep, nearly level, poorly drained and very poorly drained soil is in depressions and drainageways in glacial lake basins and on outwash plains. It is subject to ponding. Individual areas are irregular in shape and generally range from 5 to 120 acres in size.

Typically, the surface layer is black, very friable loamy sand about 8 inches thick. The upper part of the substratum is dark grayish brown and brown, mottled sand. The lower part to a depth of about 60 inches is reddish brown, mottled silty clay.

Included with this soil in mapping are small areas of Allendale, Pickford, and Roscommon soils. The somewhat poorly drained Allendale soils are in the slightly higher landscape positions. Pickford and Roscommon soils are in landscape positions similar to those of the Pinconning soil. Pickford soils are silty clay loam in the upper part of the profile. Roscommon soils are sandy throughout. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the sandy upper part of the profile in the Pinconning soil and slow or very slow in the lower clayey deposits. The available water capacity is low. The root development for most crops is restricted most of the year by a high water table at or above the surface or within a depth of 1 foot.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The soil is usually wet most of the year. Ruts form easily when wheeled skidders are used during the wet periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the snow cover is thick. All-weather roads require a gravel base. Culverts are needed to maintain the natural drainage system. Wetness and low strength are severe limitations on landing sites. The better suited adjacent soils may be needed as sites for landings. Trees generally are not planted on this soil because of the excessive wetness. Reforestation is limited to natural regeneration or hand planting. Seedling mortality, which is caused by wetness, can be minimized by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

Unless drained, this soil is unsuited to cultivated crops. If drained, however, it is suited to corn and small grain and to legumes and grasses for hay and pasture.

A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains can improve internal drainage. If the water table is excessively lowered, however, crop yields are limited by the low available water capacity in most years. Ditchbanks are easily eroded, and vertical banks cave in and plug the ditch. Where tile drains are installed, loose sand can enter the tile lines unless a suitable filter is used. Areas that are drained and cultivated are subject to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

Unless drained, this soil is unsuitable for most forage species. If drained, however, it is suited to pasture and hay. Forage yields are limited by the low available water capacity unless fertilizer and irrigation water are applied. Overgrazing depletes the plant cover and results in soil blowing. Drainage systems, proper stocking rates, pasture rotation, and timely deferment of grazing are needed to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields because of the ponding, the rapid permeability in the upper part of the profile, and the slow or very slow permeability in the lower part. Because of the ponding, the soil is generally unsuited to dwellings. A high shrink-swell potential is also a hazard on sites for dwellings with basements. The ponding is difficult to overcome. A better suited site should be selected. The soil is poorly suited to local roads and streets because of the ponding. This hazard can be overcome by constructing the roads and streets on raised, well compacted fill material. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is Vw, undrained. The woodland ordination symbol is 3W. A habitat type has not been assigned.

Pt—Pits. These pits are excavations from which sand, gravel, dolomite, or igneous or metamorphic bedrock has been removed. They are in areas of Alpena, Cunard, Ishpeming, Mancelona, Menahga, Michigamme, Nadeau, Padus, Pence, Rousseau, Shawano, or Summerville soils. Individual pits are irregular in shape and generally range from 5 to 40 acres in size.

Typically, the material on the bottom and side walls of the pits is stratified sand and gravel or sand. In some areas it is dolomite or igneous or metamorphic bedrock.

Included with this unit in mapping are areas of spoil. The spoil includes soil pushed from the pit area before excavation and piles of material that was discarded because it did not contain enough gravel, contained rock fragments not suitable for crushing, or was otherwise unsuitable for the intended use.

Many pits are still in use. Some have been abandoned and are overgrown with brush and weeds or are filled with water (fig. 12). The main management concern is the reclamation of the area after excavation. Before most areas can support a plant cover, land shaping and additions of suitable topsoil are needed.

Onsite investigation is needed to determine the suitability of this unit for most uses.

This map unit is not assigned a land capability classification, a woodland ordination symbol, or a habitat type.

Rc—Roscommon mucky loamy sand, 0 to 2 percent slopes. This deep, nearly level, poorly drained and very poorly drained soil is in depressions and drainageways on outwash plains and moraines. It is subject to ponding. Individual areas are irregular in shape and generally range from 5 to 120 acres in size.

Typically, the surface layer is black, very friable mucky loamy sand about 7 inches thick. The substratum to a depth of about 60 inches is sand. It is light brownish gray in the upper part and grayish brown in the lower part.

Included with this soil in mapping are small areas of Au Gres, Brevort, and Markey soils. The somewhat poorly drained Au Gres soils are in the slightly higher landscape positions. Brevort and Markey soils are in landscape positions similar to those of the Roscommon soil. Brevort soils are underlain by loamy deposits at a depth of 20 to 40 inches. Markey soils are muck to a depth of 16 to 51 inches. Also included are some areas that are covered with water behind beaver dams. Included areas make up 5 to 15 percent of the unit.

Permeability is rapid in the Roscommon soil. The available water capacity is low. The root development for most crops is restricted by a seasonal high water table at or above the surface or within a depth of 1 foot.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The soil is usually wet most of the year. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. Culverts are needed to maintain the natural drainage system. Wetness is a severe limitation on landing sites. The better suited adjacent soils may be needed as sites for landings. Trees generally are not planted on this soil because of the

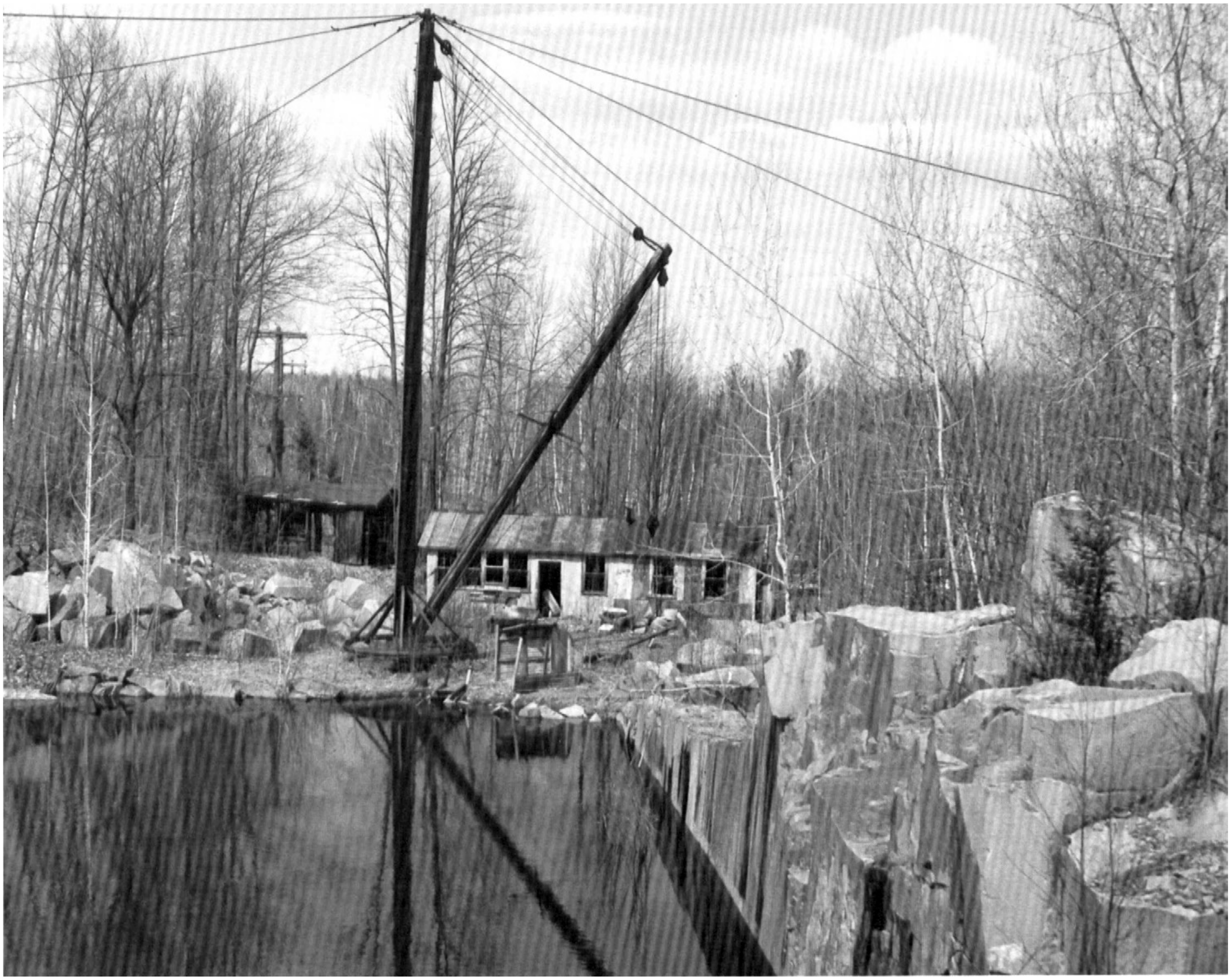

Figure 12.—An abandoned water-filled granite quarry in an area of Pits.

excessive wetness. Reforestation is limited to natural regeneration or hand planting. Seedling mortality, which is caused by wetness, can be minimized by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

Unless drained, this soil is unsuited to cultivated crops. If drained, however, it is suited to corn and small grain and to legumes and grasses for hay and pasture. A surface drainage system can remove excess water rapidly. Open ditches can improve internal drainage. If the water table is excessively lowered, however, crop

yields are limited by the low available water capacity in most years. Ditchbanks are easily eroded, and vertical banks cave in and plug the ditch. Areas that are drained and cultivated are subject to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

Unless drained, this soil is unsuitable for most forage species. If drained, however, it is suited to pasture and hay. Forage yields are limited by the low available water capacity unless fertilizer and irrigation water are applied. Overgrazing depletes the plant cover and results in soil blowing. Drainage systems, proper stocking rates, pasture rotation, and timely deferment of grazing are needed to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields because of the ponding and a poor filtering capacity caused by the rapid permeability. Because of the ponding, the soil is generally unsuited to dwellings. The ponding is difficult to overcome. A better suited site should be selected. The soil is poorly suited to local roads and streets because of the ponding. This hazard can be overcome by constructing the roads and streets on raised, well compacted fill material. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is VIw, undrained. The woodland ordination symbol is 6W. A habitat type has not been assigned.

Rm—Roscommon-Rock outcrop complex, 0 to 2 percent slopes. This map unit consists of a deep, nearly level, poorly drained and very poorly drained Roscommon soil and undifferentiated igneous or metamorphic Rock outcrop. The Roscommon soil is in depressions and drainageways on outwash plains and moraines. It is subject to ponding. Individual areas are mainly irregular in shape and generally range from 10 to 700 acres in size. They are 40 to 65 percent Roscommon mucky loamy sand and 10 to 35 percent bedrock outcrop. The Roscommon soil and Rock outcrop occur as areas so intricately intermingled or so small that separating them in mapping is not practical.

Typically, the Roscommon soil has a surface layer of black, very friable mucky loamy sand about 7 inches thick. The substratum to a depth of about 60 inches is light brownish gray and grayish brown sand.

The Rock outcrop is exposed undifferentiated igneous or metamorphic bedrock. Some rock outcrops have nearly vertical sides and extend to a height of as much as 60 feet.

Included with this unit in mapping are small areas of Au Gres, Charlevoix, Ensley, Ishpeming, Markey, Menahga, and Michigamme soils. The somewhat poorly drained Au Gres and Charlevoix soils are slightly higher on the landscape than the Roscommon soil. Charlevoix soils are loamy throughout. Ensley and Markey soils are in landscape positions similar to those of the Roscommon soil. Ensley soils are loamy throughout. Markey soils are organic to a depth of 16 to 51 inches. The somewhat excessively drained Ishpeming soils are on ridges. They are underlain by igneous or metamorphic bedrock at a depth of 20 to 40 inches. The excessively drained Menahga soils are on ridges and knobs. The well drained Michigamme soils are on ridges. They formed in loamy deposits underlain by igneous or metamorphic bedrock at a depth of 20 to 40 inches. Also included are some areas of water behind beaver dams. Included areas make up 0 to 15 percent of the unit.

Permeability is rapid in the Roscommon soil. The available water capacity is low. The root development for most crops is restricted by a seasonal high water table at or above the surface or within a depth of 1 foot.

Areas of this unit are used as woodland. The Roscommon soil is suited to trees. Trees of commercial quality do not grow in areas of rock outcrops. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The Roscommon soil is usually wet most of the year. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. Culverts are needed to maintain the natural drainage system. The bedrock escarpments restrict the movement of logging equipment. The better suited adjacent soils may be needed as sites for landings. Trees generally are not planted on this soil because of excessive wetness. Reforestation is limited to natural regeneration or hand planting. Seedling mortality, which is caused by wetness, can be minimized by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to

control competing vegetation. Subsequent invading species should be controlled.

The Roscommon soil is unsuitable as cropland and pasture because of the wetness, the low available water capacity, and the many outcrops of igneous and metamorphic bedrock, which hinder drainage and tillage.

The Roscommon soil is generally unsuited to septic tank absorption fields because of the ponding and a poor filtering capacity, which is caused by the rapid permeability. Because of the ponding, the Roscommon soil is generally unsuited to dwellings. The ponding is difficult to overcome. A better suited site should be selected. The soil is poorly suited to local roads and streets because of the ponding. This hazard can be overcome by constructing the roads and streets on raised, well compacted fill material. Providing adequate side ditches and culverts helps to maintain the natural drainage system. Straight roads may not be possible because of the rock outcrops.

The land capability classification is VIIs. The woodland ordination symbol is 6W for the Roscommon soil. A habitat type has not been assigned.

RsB—Rousseau loamy fine sand, 1 to 6 percent slopes. This deep, nearly level and gently sloping, moderately well drained soil is on flats and ridges on outwash plains and in glacial lake basins. Individual areas are irregular in shape and generally range from 3 to 160 acres in size.

Typically, the surface layer is black, very friable loamy fine sand about 2 inches thick. The subsurface layer is gray, very friable fine sand about 4 inches thick. The subsoil is loose fine sand about 26 inches thick. It is dark reddish brown in the upper part, dark brown in the next part, and brown in the lower part. The substratum to a depth of about 60 inches is brown, mottled fine sand.

Included with this soil in mapping are small areas of Croswell, Shawano, and Wainola soils. Croswell soils are in landscape positions similar to those of the Rousseau soil. They formed in deposits of sandy material, which is dominantly medium in size. Shawano soils are excessively drained. They are in the slightly higher, convex areas. The somewhat poorly drained Wainola soils are in depressions and drainageways. Also included are areas of Rousseau soils near or within cities, where urban construction has modified and mixed the soil layers. Included soils make up 0 to 15 percent of the unit.

Permeability is moderately rapid or rapid in the Rousseau soil. Surface runoff is slow. The available water capacity is low. A water table is at a depth of 2.5 to 6.0 feet during wet seasons.

Most areas of this soil are used as woodland. Some are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations and seedling mortality. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel. Seedling mortality is caused by droughtiness. Planting when the soil is moist can reduce seedling losses. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture, but crop yields are limited by the low available water capacity. Applications of fertilizer and irrigation water improve productivity. The soil is suited to sprinkler irrigation. Because of the moderately rapid or rapid permeability, the irrigation rate should be limited. Limiting the rate helps to prevent the leaching of plant nutrients from the root zone. Water erosion generally is not a problem, but the soil is subject to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling soil blowing. Overgrazing, however, depletes the plant cover. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless the soil is irrigated. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and the moderately rapid or rapid permeability. Mounding with suitable filtering material helps to overcome these limitations. The soil is suited to dwellings without basements. It is only moderately suited to dwellings with basements because of the seasonal high water table. This limitation can be overcome by constructing the basements above the level of wetness. It can also be overcome by installing tile drains around the foundations and providing a gravity outlet or another dependable outlet. The soil is suited to local roads and streets.

The land capability classification is IIIs. The

woodland ordination symbol is 5S. The primary habitat type is AQV, and the secondary habitat type is PMV.

Sa—Saprists and Psammaquents, ponded. These deep, nearly level, very poorly drained to inundated soils are in depressions and along streams and lakeshores. They are ponded most of the year and are subject to flooding. Individual areas are irregular in shape and generally range from 5 to 400 acres in size. A single mapped area may be either Saprists or Psammaquents, or it may contain both soils. The two soils have similar behavior characteristics for present or anticipated uses in the survey area, and mapping them separately was not considered practical or necessary.

These soils have a wide range of colors and textures. Typically, the Saprists are muck to a depth of 16 to more than 51 inches. The Psammaquents are sandy throughout. In some places sandy or loamy strata are in the Saprists. In other places loamy strata are in the Psammaquents. In some areas the Psammaquents have a muck surface layer as much as 16 inches thick.

Included with these soils in mapping are small areas of Arnheim, Deford, Markey, Roscommon, and Seelyeville soils. These included soils are in areas that do not remain ponded throughout most of the year. Included soils make up 10 to 15 percent of the unit.

Permeability and the available water capacity are too variable to rate for these soils. Surface runoff is ponded. The seasonal high water table is above or near the surface during much of the year.

Most areas of these soils support low-growing wetland vegetation, such as cattails, rushes, sedges, and willows (fig. 13). The seasonal high water table restricts plant growth to only those species that are well suited to wetland conditions.

These soils are not suited to woodland. They do not support tree growth of merchantable size and quality.

These soils are unsuitable for cultivated crops, hay, and pasture because of the flooding and the ponding. Most areas cannot be drained.

These soils are unsuited to septic tank absorption fields, dwellings, and local roads and streets because of the ponding and the flooding. Overcoming these hazards is difficult. A more suitable site should be selected.

The land capability classification is VIIIw. A woodland ordination symbol or habitat type has not been assigned.

SbB—Sarona fine sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on broad ridges on moraines. Individual areas are irregular in shape and generally range from 10 to 1,000 acres in size.

Typically, about ½ inch of black, partially decomposed forest litter is at the surface. The surface layer is very dark gray, very friable fine sandy loam about 4 inches thick. The subsurface layer is pinkish gray, friable fine sandy loam about 2 inches thick. The subsoil is about 22 inches of strong brown, friable fine sandy loam and brown, friable sandy loam. The next 3 inches is yellowish red and brown, friable sandy loam. Below this is about 7 inches of reddish brown and dark brown, firm and friable sandy loam. The substratum to a depth of about 60 inches is strong brown loamy sand. In some places the surface layer is very fine sandy loam. In other places the slope is as much as 12 percent.

Included with this soil in mapping are small areas of Goodman, Keweenaw, Monico, and Padus soils. Goodman, Keweenaw, and Padus soils are in landscape positions similar to those of the Sarona soil. Goodman soils are silty in the upper 15 to 35 inches. Keweenaw soils are sandy in the surface layer and the upper part of the subsoil and in the substratum. Padus soils are underlain by stratified sand or sand and gravel. The somewhat poorly drained Monico soils are in depressions and drainageways. Also included are areas of Sarona soils that have stones and boulders exposed on the surface. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Sarona soil. Surface runoff is slow. The available water capacity is moderate. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most areas of this soil are used as woodland. Some are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. Unsurfaced roads are easily rutted during wet periods. On sites for all-weather roads, a gravel base is needed. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to

Figure 13.—An area of Saprists and Psammaquents, ponded, along the Peshtigo River.

control competing vegetation. Subsequent invading species should be controlled.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, water erosion is a slight or moderate hazard. It can be controlled by conservation tillage, a conservation cropping system, proper management of crop residue, contour farming, contour stripcropping, and grassed waterways. Regular additions of organic material help to maintain fertility and tilth and increase the rate of water infiltration.

A cover of pasture plants or hay helps to control water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet results in compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to dwellings. It is only moderately suited to septic tank absorption fields because of the moderate permeability. Enlarging the absorption field helps to overcome this limitation. The soil is only moderately suited to local roads and streets because of a moderate potential for frost action. Covering or replacing the upper part of the soil with coarse textured

base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 3L. The primary habitat type is AViO, and the secondary habitat type is ATD.

SbC—Sarona fine sandy loam, 6 to 15 percent slopes. This deep, sloping and moderately steep, well drained soil is on ridgetops and the side slopes of ridges on moraines. Individual areas are irregular in shape and generally range from 5 to 800 acres in size.

Typically, the surface layer is black, very friable fine sandy loam about 1 inch thick. The subsurface layer is pinkish gray, friable fine sandy loam about 2 inches thick. The subsoil is about 36 inches thick. It is brown, very friable fine sandy loam in the upper part; reddish brown, friable loam in the next part; and reddish brown, friable loamy sand in the lower part. The substratum to a depth of about 60 inches is brown loamy sand. In some places the surface layer is silt loam. In other places the slope is as little as 2 percent or as much as 20 percent.

Included with this soil in mapping are small areas of Keweenaw and Padus soils. These soils are in landscape positions similar to those of the Sarona soil. Keweenaw soils are sandy in the surface layer and the upper part of the subsoil and in the substratum. Padus soils are underlain by stratified sand or sand and gravel. Also included are areas of Sarona soils that have stones and boulders exposed on the surface. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Sarona soil. Surface runoff is medium in cultivated areas. The available water capacity is moderate. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most areas of this soil are used as woodland. A few are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations. The use of equipment is restricted during excessively wet periods by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. Unsurfaced roads are easily rutted during wet periods. On sites for all-weather roads, a gravel base is needed. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, water erosion is a moderate hazard. It can be controlled by conservation tillage, a conservation cropping system, proper management of crop residue, contour farming, contour stripcropping, and grassed waterways. Regular additions of organic material help to maintain fertility and tilth and increase the rate of water infiltration.

A cover of pasture plants or hay helps to control water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet results in compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is only moderately suited to septic tank absorption fields because of the moderate permeability and the slope. Mounding with suitable filtering material or enlarging the absorption field helps to overcome the limited permeability. Installing a trench absorption system on the contour helps to overcome the slope. The soil is only moderately suited to dwellings because of the slope. Cutting and filling can overcome this limitation. The soil is only moderately suited to local roads and streets because of the slope and a moderate potential for frost action. Cutting and filling or constructing roads on the contour helps to overcome the slope. Covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the road damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3L. The primary habitat type is AViO, and the secondary habitat type is ATD.

SbD—Sarona fine sandy loam, 15 to 25 percent slopes. This deep, moderately steep and steep, well drained soil is on the sides of ridges on moraines. Individual areas are elongated or irregular in shape and generally range from 10 to 120 acres in size.

Typically, the surface layer is very dark gray, very friable fine sandy loam about 3 inches thick. The subsurface layer is dark brown, friable sandy loam about 3 inches thick. The subsoil is about 24 inches

thick. It is brown and light brown, very friable sandy loam in the upper part; yellowish red, friable loam in the next part; and reddish brown, very friable sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish red sandy loam. In some places the surface layer is silt loam or very fine sandy loam. In other places the slope is as little as 8 percent.

Included with this soil in mapping are small areas of Padus soils in landscape positions similar to those of the Sarona soil. Padus soils are underlain by stratified sand or sand and gravel. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Sarona soil. The available water capacity also is moderate.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are the hazard of water erosion and equipment limitations. The erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads on the contour help to prevent excessive soil loss. Seeding exposed areas after logging helps to establish a protective vegetative cover. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary. The slope also limits the selection of sites for logging roads and landings. Logging roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

Because of a severe hazard of water erosion, this soil is generally unsuitable for cultivated crops. It is suited to pasture and hay. Overgrazing, however, depletes the plant cover and results in water erosion. Proper stocking rates, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields, dwellings, and local roads and streets because of the slope. The slope can be overcome by cutting and filling and by establishing septic tank absorption fields and roads on the contour. Also, the less sloping areas can be selected as building sites.

The land capability classification is VIe. The woodland ordination symbol is 3R. The primary habitat type is AViO, and the secondary habitat type is ATD.

ScB—Sayner loamy sand, 1 to 6 percent slopes. This deep, nearly level and gently sloping, excessively drained soil is on ridges on outwash plains and moraines. Individual areas are irregular in shape and generally range from 10 to 120 acres in size.

Typically, the surface layer is black, very friable loamy sand about 4 inches thick. The subsoil is about 21 inches thick. It is reddish brown, very friable loamy sand in the upper part and strong brown, very friable gravelly sand in the lower part. The substratum to a depth of about 60 inches is strong brown gravelly sand. In places the slope is as much as 15 percent.

Included with this soil in mapping are small areas of Keweenaw and Menahga soils. These soils are in landscape positions similar to those of the Sayner soil. The subsoil of the Keweenaw soils has a layer that is typically sandy loam and that has a clay accumulation. Menahga soils typically contain less gravel in the lower part of the subsoil and in the substratum than the Sayner soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Sayner soil and rapid or very rapid in the substratum. The available water capacity is low.

Most areas of this soil are used as woodland. A few are used as cropland or pasture. Some areas that were formerly cropland have been planted to red pine or are reverting naturally to woodland. The substratum is a probable source of sand and gravel.

This soil is suited to trees. No major concerns affect the management of woodland. The low available water capacity, however, limits the growth of trees, especially hardwoods. Hardwoods do not grow as well as conifers on the more droughty soils.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture, but crop yields are limited by the low available water capacity. Applications of fertilizer and irrigation water improve productivity. The soil is suited to sprinkler irrigation. Because of the rapid or very rapid permeability, the irrigation rate should be limited. Limiting the rate helps to prevent the leaching of plant nutrients from the root zone. Water erosion generally is not a problem, but the soil is subject to soil blowing. Conservation tillage,

winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling soil blowing. Overgrazing, however, depletes the plant cover. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless the soil is irrigated. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

The soil is suited to dwellings and to local roads and streets. The effluent in septic tank absorption fields drains satisfactorily through the soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum.

The land capability classification is IVs. The woodland ordination symbol is 7A. The primary habitat type is AQV, and the secondary habitat type is PMV.

ScC—Sayner loamy sand, 6 to 15 percent slopes. This deep, sloping and moderately steep, excessively drained soil is on the side slopes of ridges on outwash plains and moraines. Individual areas are elongated and generally range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loamy sand about 3 inches thick. The subsoil is about 22 inches thick. It is brown, very friable loamy sand in the upper part and strong brown, very friable gravelly sand in the lower part. The substratum to a depth of about 60 inches is brown gravelly sand. In places the slope is as little as 2 percent.

Included with this soil in mapping are small areas of Keweenaw, Menahga, and Pence soils. These soils are in landscape positions similar to those of the Sayner soil. The subsoil of the Keweenaw soils has a layer that is typically sandy loam and that has a clay accumulation. Menahga soils typically contain less gravel in the lower part of the subsoil and in the substratum than the Sayner soil. Pence soils have a loamy mantle 12 to 20 inches thick. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Sayner soil and rapid or very rapid in the substratum. The available water capacity is low.

Most areas of this soil are used as woodland. A few are used as cropland or pasture. The substratum is a probable source of sand and gravel.

This soil is suited to trees. The main concern in managing woodland is the slope, which limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils.

This soil is generally unsuited to corn and small grain because of the low available water capacity, the hazard of soil blowing, and a moderate hazard of water erosion. It is suited to grasses and legumes for hay and pasture, but crop yields are limited by the low available water capacity. Applications of fertilizer and irrigation water improve productivity. The soil is suited to sprinkler irrigation. Because of the rapid or very rapid permeability, the irrigation rate should be limited. Limiting the rate helps to prevent the leaching of plant nutrients from the root zone. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling water erosion and soil blowing. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless the soil is irrigated. Overgrazing depletes the plant cover and results in water erosion and soil blowing. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

The effluent in septic tank absorption fields drains satisfactorily through this soil, but it can pollute ground water because of the rapid or very rapid permeability in the substratum. The soil is only moderately suited to dwellings and to local roads and streets because of the slope. The slope can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required.

The land capability classification is VIs. The woodland ordination symbol is 7A. The primary habitat type is AQV, and the secondary habitat type is PMV.

Sd—Seelyeville and Markey mucks, 0 to 1 percent slopes. These deep, nearly level, very poorly drained soils are in depressions and drainageways on outwash plains, on moraines, on stream terraces, or in glacial lake basins. They are subject to ponding. Individual areas are irregular in shape and generally range from 3 to 2,500 acres in size. A single mapped area may be either Seelyeville or Markey muck, or it may contain both soils. The two soils have similar behavior

characteristics for present or anticipated uses in the survey area, and mapping them separately was not considered practical or necessary.

Typically, the upper layer of the Seelyeville soil is very dark brown muck about 30 inches thick. The lower layer to a depth of about 60 inches is black muck.

Typically, the upper layer of the Markey soil is black and very dark brown muck about 21 inches thick. The substratum to a depth of about 60 inches is fine sand. It is very dark gray in the upper part and grayish brown and mottled in the lower part.

Included with these soils in mapping are some small areas of Deford, Loxley, and Roscommon soils. These included soils are in landscape positions similar to those of the Seelyeville and Markey soils. Deford soils have a thin organic layer over fine sand. Loxley soils formed in organic material that is extremely acid. Roscommon soils are sandy throughout. Also included are small areas where the organic material is underlain by marl and areas of water behind beaver dams. Included areas make up 0 to 15 percent of the unit.

Permeability is moderately slow to moderately rapid in the Seelyeville soil. It is moderately slow to moderately rapid in the organic material in the Markey soil and rapid in the substratum. Surface runoff is very slow in both soils. The available water capacity is very high. The root development for most crops is restricted most of the year by a water table at or above the surface or within a depth of 1 foot.

Most areas of these soils are used as woodland. Some have been drained and are used as cropland or pasture. Some areas, commonly those adjacent to streams, support native wetland vegetation of marsh grasses, sedges, reeds, cattails, and speckled alder.

These soils are suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The use of equipment is generally limited to the winter months when the soils are frozen or the snow cover is thick. Reforestation is limited to natural regeneration. Trees generally are not planted on these soils because of the wetness, severe seedling mortality, and plant competition. A shallow rooting depth, which is caused by wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

Unless drained, these soils are unsuitable for cultivated crops. If drained, however, they are suited to corn for silage and to small grain. Open ditches and tile drains can improve internal drainage, but some areas do not have suitable outlets. Ditchbanks are easily eroded unless they are protected by a vegetative cover. Vertical banks cave in and plug the ditch. A suitable filter is needed around the tile drains to keep the loose sand in the substratum of the Markey soil from entering the tile lines. Drained areas are subject to soil blowing. Conservation tillage, winter cover crops, field windbreaks, and wind stripcropping help to prevent excessive soil loss. If the water table is excessively lowered, subsidence can occur. Controlled drainage minimizes subsidence. The number of frost-free days per growing season is lower on these soils than on the adjacent upland soils because of cold air drainage.

Unless drained, these soils are unsuitable for most forage species. Reed canarygrass is the only suitable species. If the soils are drained, red clover can be grown, but low soil strength limits grazing and the use of machinery.

These soils are generally unsuited to septic tank absorption fields and to dwellings, mainly because of the ponding and the subsidence. Overcoming these limitations is difficult. A more suitable site should be selected. The soils are poorly suited to local roads and streets because of the ponding and the subsidence and because of a high potential for frost action on the Markey soil (fig. 14). Overcoming these limitations is difficult. A more suitable site should be selected.

The land capability classification is VIw, undrained. The woodland ordination symbol is 6W. A habitat type has not been assigned.

SeA—Selkirk silt loam, 0 to 3 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is in drainageways and depressions in glacial lake basins. Individual areas are irregular in shape and generally range from 5 to 80 acres in size.

Typically, the surface layer is black, very friable silt loam about 7 inches thick. The subsurface layer is grayish brown, mottled, friable silt loam about 3 inches thick. The next layer is brown and grayish brown, mottled, friable silty clay loam about 3 inches thick. The subsoil is reddish brown, mottled, firm silty clay about 15 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled silty clay. In places the surface layer is silty clay loam or silty clay.

Included with this soil in mapping are small areas of

Figure 14.—A road constructed in an area of Seelyeville and Markey mucks, 0 to 1 percent slopes. These soils are poorly suited to this use, and considerable cost and effort are required to overcome the limitations.

Allendale, Hibbing, and Pickford soils. Allendale soils are sandy in the upper 20 to 40 inches. The well drained Hibbing soils are on the slightly higher ridges. The poorly drained Pickford soils are in the lower areas. Included soils make up 2 to 15 percent of the unit.

Permeability is slow in the Selkirk soil. The available water capacity is high. The root development for most crops is restricted by a seasonal high water table at a depth of 6.0 inches to 1.5 feet.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The use of equipment is restricted in spring, in late fall, and in other excessively wet periods

by the seasonal high water table and by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for all-weather roads, a gravel base is needed. Culverts are needed to maintain the natural drainage system. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment. Also, they can be established on the better suited adjacent soils. Trees generally are not planted on this soil because of the excessive wetness. Reforestation is limited to natural regeneration or hand planting. Seedling mortality, which is caused by wetness, can be minimized by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

If drained, this soil is suited to corn and small grain and to legumes and grasses for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains can improve internal drainage. Ditchbanks are easily eroded unless they are protected by a vegetative cover. Proper management of crop residue and additions of other organic material improve tilth and fertility and increase the organic matter content and the rate of water infiltration.

If drained, this soil is suited to pasture and hay. Overgrazing depletes the plant cover and increases the extent of undesirable plant species. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and reduces the rate of water infiltration. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields because of the high water table and the slow permeability. Overcoming these limitations is difficult. A better suited site should be selected. The soil is poorly suited to dwellings because of the high water table and a high shrink-swell potential. The wetness can be overcome by constructing dwellings without basements, building on fill material, or constructing the basements above the level of wetness. The wetness can also be overcome by installing tile drains around the foundations and providing a gravity outlet or another dependable outlet. The high shrink-swell potential can be overcome by placing a layer of coarse material, such as sand or gravel, under and around the foundations. Installing tile drains around the foundations helps to remove excess water. The soil is poorly suited to local roads and streets because of the high shrink-swell potential, low strength, and the high water table. These limitations can be overcome by adding well compacted fill material, which can raise the roadbed above the level of wetness. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is IIIw. The woodland ordination symbol is 6C. The habitat type is TMC.

SfB—Shawano loamy fine sand, 2 to 6 percent slopes. This deep, gently sloping, excessively drained soil is on broad ridges on outwash plains and in glacial lake basins. Individual areas are irregular in shape and generally range from 3 to 500 acres in size.

Typically, the surface layer is very dark brown, very friable loamy fine sand about 2 inches thick. The next 2 inches is dark brown, very friable fine sand. The subsoil is loose fine sand about 22 inches thick. It is brown in the upper part and strong brown in the lower part. The substratum to a depth of about 60 inches is brown fine sand. In some places the surface layer is fine sandy loam. In other places the slope is as much as 12 percent.

Included with this soil in mapping are small areas of Menahga, Rousseau, and Wainola soils. Menahga soils are in landscape positions similar to those of the Shawano soil. They formed dominantly in medium or coarse sandy material. The moderately well drained Rousseau soils are in the slightly lower landscape positions. The somewhat poorly drained Wainola soils are in depressions and drainageways. Also included are areas of Shawano soils near cities, where urban construction has modified and mixed the soil layers. Included soils make up 0 to 15 percent of the unit.

Permeability is rapid in the Shawano soil. Surface runoff is slow. The available water capacity is low. The surface layer is very friable and can be easily tilled.

Most areas of this soil are used as woodland. Some are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations and seedling mortality. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and logging roads that are used repeatedly can be stabilized with gravel. Seedling mortality, which is caused by droughtiness, can be reduced by planting when the soil is moist. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate.

This soil is suited to corn and small grain and to grasses and legumes for hay and pasture, but crop yields are limited by the low available water capacity. Applications of fertilizer and irrigation water improve productivity. The soil is suited to sprinkler irrigation. Because of the rapid permeability, the irrigation rate should be limited. Limiting the rate helps to prevent the leaching of plant nutrients from the root zone. Water erosion generally is not a problem, but the soil is subject to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling soil blowing. Overgrazing, however, depletes the plant cover. Forage yields generally are low unless fertilizer and irrigation water are applied. The best planting time is early in the spring, before the soil has had a chance to dry. Planting later in the year is likely to result in a poor survival rate unless the soil is irrigated. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

The soil is suited to dwellings and to local roads and streets. The effluent in septic tank absorption fields drains satisfactorily through the soil, but it can pollute ground water because of the rapid permeability.

The land capability classification is IVs. The woodland ordination symbol is 4S. The primary habitat type is AQV, and the secondary habitat type is PMV.

SfC—Shawano loamy fine sand, 6 to 12 percent slopes. This deep, sloping, excessively drained soil is on ridges and the side slopes of ridges on outwash plains and in glacial lake basins. Individual areas are elongated or irregular in shape and generally range from 3 to 200 acres in size.

Typically, the surface layer is dark gray, very friable loamy fine sand about 4 inches thick. The subsoil is strong brown, loose fine sand about 16 inches thick. The substratum to a depth of about 60 inches is brown fine sand. In places the slope is as little as 2 percent or as much as 20 percent.

Included with this soil in mapping are small areas of Menahga soils in landscape positions similar to those of the Shawano soil. Menahga soils formed dominantly in medium or coarse sandy material. Included soils make up 1 to 15 percent of the unit.

Permeability is rapid in the Shawano soil. The available water capacity is low.

Most areas of this soil are used as woodland. A few are used as cropland or pasture. Some areas that were formerly cropland have been planted to red pine or are reverting naturally to woodland.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations and seedling mortality. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and logging roads that are used repeatedly can be stabilized with gravel. The slope limits the selection of landing sites. Landings can be established on the nearly level and gently sloping included or adjacent soils. Seedling mortality, which is caused by droughtiness, can be reduced by planting when the soil is moist. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate.

This soil is generally unsuited to cultivated crops because of the low available water capacity, the hazard of soil blowing, and a severe hazard of water erosion.

A cover of pasture plants is effective in controlling water erosion and soil blowing. Overgrazing, however, depletes the plant cover. Proper stocking rates, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

The effluent in septic tank absorption fields drains satisfactorily through this soil, but it can pollute ground water because of the rapid permeability. The soil is only moderately suited to dwellings and to local roads and streets because of the slope. The slope can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required.

The land capability classification is VIs. The woodland ordination symbol is 4S. The primary habitat type is AQV, and the secondary habitat type is PMV.

SfD—Shawano loamy fine sand, 12 to 30 percent slopes. This deep, moderately steep and steep, excessively drained soil is on the side slopes of ridges on outwash plains and in glacial lake basins. Individual areas are long and narrow or irregular in shape and

generally range from 5 to 60 acres in size.

Typically, the surface layer is black, very friable loamy fine sand about 3 inches thick. The subsurface layer is dark brown, very friable loamy fine sand about 2 inches thick. The subsoil is brown and strong brown, loose fine sand about 18 inches thick. The substratum to a depth of about 60 inches is brown fine sand. In places the slope is less than 12 percent.

Included with this soil in mapping are small areas of Menahga soils in landscape positions similar to those of the Shawano soil. Menahga soils formed dominantly in medium or coarse sandy material. Included soils make up 2 to 15 percent of the unit.

Permeability is rapid in the Shawano soil. The available water capacity is low.

Most areas of this soil are used as woodland. The soil is suited to trees. The main concerns in managing woodland are the hazard of water erosion, seedling mortality, and equipment limitations. The erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads and trails on the contour help to prevent excessive soil loss. Seeding exposed areas after logging helps to establish a protective vegetative cover. Seedling mortality, which is caused by droughtiness, can be reduced by planting when the soil is moist. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate.

In areas where the slope limits the use of equipment, yarding logs by cable may be necessary. The slope also limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established in areas of the less sloping included or adjacent soils. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel.

This soil is generally unsuited to cultivated crops and pasture because of the low available water capacity, the hazard of soil blowing, and a severe hazard of water erosion.

This soil is poorly suited to septic tank absorption fields, dwellings, and local roads and streets because of the slope. The slope can be reduced by cutting and filling. Also, sites in areas of the less sloping included soils can be selected. Local roads and streets can be constructed on the contour. The effluent in septic tank absorption fields drains satisfactorily through the soil, but it can pollute ground water because of the rapid permeability.

The land capability classification is VIIs. The woodland ordination symbol is 4R. The primary habitat type is AQV, and the secondary habitat type is PMV.

SuB—Summerville fine sandy loam, 1 to 6 percent slopes. This shallow, nearly level and gently sloping, well drained soil is on flats and ridges on ground moraines. Individual areas are irregular in shape and generally range from 3 to 60 acres in size.

Typically, the surface layer is very dark grayish brown, friable fine sandy loam about 9 inches thick. The subsoil is about 8 inches thick. It is dark reddish brown, friable fine sandy loam in the upper part; brown, very friable loam in the next part; and strong brown, very friable fine sandy loam in the lower part. Dolomite bedrock is at a depth of about 17 inches (fig. 15). In places the slope is as much as 10 percent.

Included with this soil in mapping are small areas of Bonduel and Cunard soils. The somewhat poorly drained Bonduel soils are underlain by dolomite at a depth of 20 to 40 inches. They are in depressions and drainageways. Cunard soils are underlain by dolomite at a depth of 20 to 40 inches. They are in landscape positions similar to those of the Summerville soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Summerville soil. Surface runoff is slow or medium in cultivated areas. The available water capacity is very low. The root development for most crops is restricted within a depth of 10 to 20 inches by the underlying dolomite.

Areas of this soil are used as woodland, cropland, or pasture. Areas of idle cropland are reverting naturally to woodland.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. Seedling mortality is caused by the shallow depth to dolomite and by droughtiness. Planting when the soil is moist can reduce seedling losses. Planting vigorous nursery stock also can reduce the seedling mortality rate. A shallow rooting depth, which is caused by the underlying dolomite, can result in windthrow of many trees during

Figure 15.—An exposure of dolomite in an area of Summerville fine sandy loam, 1 to 6 percent slopes.

periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

This soil is suited to small grain and to legumes and grasses for hay and pasture, but crop yields are limited by the very low available water capacity. If the soil is cultivated, the hazard of water erosion is slight or moderate. Conservation tillage, a conservation cropping system, contour farming, contour stripcropping, and grassed waterways help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields, dwellings, and local roads and streets because of the shallow depth to dolomite bedrock. Inadequately treated sewage effluent flowing through crevices in the dolomite can pollute nearby water supplies. Excavations for dwellings and for local roads and streets require heavy-duty equipment and blasting. Because of the depth to bedrock, a more suitable building site should be selected.

The land capability classification is IIIs. The woodland ordination symbol is 3D. The primary habitat type is ATM, and the secondary habitat type is PMV.

SuC—Summerville fine sandy loam, 6 to 12 percent slopes. This shallow, sloping, well drained soil is on the side slopes of ridges on ground moraines. Individual areas are long and narrow and generally range from 3 to 40 acres in size.

Typically, the surface layer is very dark grayish brown, friable fine sandy loam about 3 inches thick. The subsoil is about 16 inches thick. It is brown, very friable fine sandy loam in the upper part; reddish brown, friable sandy loam in the next part; and brown, very friable sandy loam in the lower part. Dolomite bedrock is at a depth of about 19 inches. In some places the surface layer is silt loam or loam. In other places the slope is as much as 20 percent.

Included with this soil in mapping are small areas of Cunard soils in landscape positions similar to those of the Summerville soil. They are underlain by dolomite at a depth of 20 to 40 inches. Included soils make up 1 to 15 percent of the unit.

Permeability is moderate in the Summerville soil. Surface runoff is medium or rapid in cultivated areas. The available water capacity is very low. The root development for most crops is restricted within a depth of 10 to 20 inches by the underlying dolomite.

Most areas of this soil are used as woodland. The soil is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The use of equipment is restricted in spring and in other excessively wet periods by low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Equipment should be used only when the soil is dry or the snow cover is thick. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping adjacent soils. Seedling mortality is caused by the shallow depth to dolomite and by droughtiness. Planting when the soil is moist can reduce seedling losses. Planting vigorous nursery stock also can reduce the seedling mortality rate. A shallow rooting depth, which is caused by the underlying dolomite, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

This soil is suited to small grain and to legumes and grasses for hay and pasture, but crop yields are limited by the very low available water capacity. If the soil is cultivated, the hazard of water erosion is moderate or severe. Conservation tillage, a conservation cropping system, contour farming, contour stripcropping, and grassed waterways help to prevent excessive soil loss.

A cover of pasture plants or hay is effective in controlling water erosion. Overgrazing, however, depletes the plant cover. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and increases the runoff rate and the hazard of water erosion. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is generally unsuited to septic tank absorption fields, dwellings, and local roads and streets because of the shallow depth to dolomite bedrock. Inadequately treated sewage effluent flowing through crevices in the dolomite can pollute nearby water supplies. Excavations for dwellings and for local roads and streets require heavy-duty equipment and blasting. Because of the depth to bedrock, a more suitable building site should be selected.

The land capability classification is IVe. The woodland ordination symbol is 3D. The primary habitat type is ATM, and the secondary habitat type is PMV.

Ud—Udorthents, loamy, nearly level. These deep soils are fill material that has been placed in drainageways, depressions, and areas along the margins of lakes and reservoirs. Individual areas are irregular in shape and generally range from 3 to 160 acres in size.

Typically, the fill material is sandy, but in some areas it is loamy. The content of gravel and cobbles varies considerably. The fill material commonly covers soils of the Deford, Markey, or Wainola series or areas of Saprists and Psammaquents.

Included with these soils in mapping are small areas of Rousseau soils in the slightly higher landscape positions. They are moderately well drained and are sandy throughout. Also included are areas where the fill material includes layers of sawdust. Included areas make up 7 to 15 percent of the unit.

Permeability and the available water capacity are too variable to rate for these soils.

Most areas of these soils are used as sites for buildings, roads, or parking lots or for other nonfarm uses.

These soils are poorly suited to cultivated crops, pasture, woodland, and most engineering uses. Careful onsite investigation is needed to determine the suitability of the soils for septic tank absorption fields, dwellings, or local roads and streets.

This map unit is not assigned a land capability classification, a woodland ordination symbol, or a habitat type.

Ur—Urban land. This map unit consists of areas where the land is mostly covered by streets, parking lots, buildings, and other urban structures. Individual areas are square or rectangular and generally range from 5 to 50 acres in size.

Included with this unit in mapping are small areas of Rousseau, Shawano, and Wainola soils. These soils are in areas that have not been covered or modified by urban construction. Rousseau soils are moderately well drained and are sandy throughout. Shawano soils are excessively drained and are sandy throughout. Wainola soils are somewhat poorly drained and are sandy throughout.

Urban land is so variable that it was not practical to determine permeability, the available water capacity, or other soil properties.

Areas of Urban land are generally unsuited to cultivated crops, pasture, and woodland. Careful onsite investigation is needed to determine the suitability of these areas for septic tank absorption fields, dwellings, or local roads and streets.

This map unit is not assigned a land capability classification, a woodland ordination symbol, or a habitat type.

WaA—Wainola loamy fine sand, 0 to 3 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is on large flats and in depressions and drainageways on outwash plains, on ground moraines, and in glacial lake basins. Individual areas are irregular in shape and generally range from 3 to 2,500 acres in size.

Typically, about ½ inch of black, partially decomposed forest litter is at the surface. The surface layer is black, very friable loamy fine sand about 2 inches thick. The subsurface layer is brown, very friable fine sand about 3 inches thick. The subsoil is about 28 inches thick. It is brown, mottled, very friable loamy fine sand and fine sand. The substratum to a depth of about 60 inches is brown, mottled fine sand.

Included with this soil in mapping are small areas of Deford, Rousseau, and Shawano soils. The poorly drained and very poorly drained Deford soils are in the lower depressions and drainageways. The moderately well drained Rousseau soils and the excessively drained Shawano soils are on the slightly higher ridges. Also included are areas of Wainola soils near cities, where urban construction has modified and mixed soil layers. Included soils make up 1 to 15 percent of the unit.

Permeability is rapid in the Wainola soil. Surface runoff is slow. The available water capacity is low. The root development for most crops is restricted by a seasonal high water table at a depth of 6.0 inches to 1.5 feet.

Most areas of this soil are used as woodland. Some have been drained and are used as cropland or pasture.

This soil is suited to trees. The main concerns in managing woodland are equipment limitations, seedling mortality, and the windthrow hazard. The use of equipment is restricted in spring and in other excessively wet periods by the seasonal high water table (fig. 16). The soil is rutted by wheeled vehicles during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. Seedling mortality is caused by droughtiness. Planting when the soil is moist can reduce seedling losses. A shallow rooting depth, which is caused by the high water table, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation. Subsequent invading species should be controlled.

If drained, this soil is suited to corn and small grain and to grasses and legumes for hay and pasture. Surface drains remove excess surface water rapidly. Open ditches and tile drains can improve subsurface drainage. Where tile drains are installed, loose sand can enter the tile lines unless a suitable filter is used. Unless protected by a plant cover, ditchbanks are easily eroded. Vertical banks can cave in and plug the ditch. Areas that are drained and cultivated are subject to soil blowing. Conservation tillage, winter cover crops, proper management of crop residue, field windbreaks, and wind stripcropping help to prevent excessive soil loss. If the water table is excessively lowered, crop yields are limited by the low available water capacity during most of the year. The soil is suited to sprinkler irrigation. Because of the rapid permeability, the irrigation rate should be limited. If the rate is excessive, plant nutrients can be leached from the root zone.

Unless drained, this soil is unsuitable for most forage species. If drained, however, it is suited to pasture and hay. Forage yields are restricted unless fertilizer and irrigation water are applied. Overgrazing depletes the

Figure 16.—Soil wetness is a major management concern during logging operations on Wainola loamy fine sand, 0 to 3 percent slopes.

plant cover and results in soil blowing. Drainage systems, proper stocking rates, pasture rotation, and timely deferment of grazing are needed to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and the rapid permeability. Overcoming these limitations is difficult. A better suited site should be selected. The soil is poorly suited to dwellings because of the seasonal high water table. Constructing dwellings without basements, building on fill material, or constructing the basements above the level of wetness helps to overcome this limitation. The wetness also can be overcome by installing tile drains around the foundations and providing a gravity outlet or another dependable outlet. Because of the wetness, the soil is poorly suited to local roads and streets. Adding suitable fill material, such as sand or gravel, can raise the roadbed above the level of wetness. Providing adequate side ditches and culverts helps to maintain the natural drainage system.

The land capability classification is IIIw. The woodland ordination symbol is 6W. The habitat type is TMC.

WrA—Worcester fine sandy loam, 0 to 3 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is in depressions and drainageways on outwash plains and ground moraines. Individual areas are irregular in shape and generally range from 10 to 80 acres in size.

Typically, the surface layer is black, very friable fine sandy loam about 2 inches thick. The subsurface layer is grayish brown, very friable fine sandy loam about 4 inches thick. The subsoil is about 9 inches of dark brown and brown, mottled, very friable fine sandy loam. The next 9 inches is brown and strong brown, mottled, very friable fine sandy loam. Below this is reddish

brown, mottled, very friable sandy loam. The substratum to a depth of about 60 inches is yellowish brown, mottled sand. In places the surface layer is sandy loam or silt loam.

Included with this soil in mapping are small areas of the well drained Padus and Pence soils on ridges. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the subsoil of the Worcester soil and rapid or very rapid in the substratum. The available water capacity is moderate. The root development for most crops is restricted by a seasonal high water table at a depth of 1 to 3 feet.

Most areas of this soil are used as woodland. The soil is suited to trees. The main concerns in managing woodland are equipment limitations and the windthrow hazard. The use of equipment is restricted in spring and in other excessively wet periods by the seasonal high water table. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and expose tree roots. Access by machinery is limited to the dry summer months or to winter months when the soil is frozen or the snow cover is thick. A shallow rooting depth, which is caused by the high water table, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

If drained, this soil is suited to corn and small grain and to legumes and grasses for hay and pasture. A surface drainage system can remove excess surface water rapidly. Open ditches and tile drains can improve internal drainage. Where tile drains are installed, loose sand can enter the tile line unless a suitable filter is used. Ditchbanks are easily eroded unless they are protected by a vegetative cover. Proper management of crop residue and additions of other organic material improve tilth and fertility and increase the organic matter content and the rate of water infiltration.

If drained, this soil is suited to pasture and hay. Overgrazing, however, depletes the plant cover and increases the extent of undesirable plant species. Grazing when the soil is wet causes compaction of the surface layer and poor tilth and reduces the rate of water infiltration. Proper stocking rates, pasture renovation, rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and the rapid or very rapid permeability in the substratum. In areas where the seasonal high water table is at a depth of more than 2 feet, these limitations can be overcome by constructing a mound of suitable filtering material. The soil is poorly suited to dwellings because of the wetness. This limitation can be overcome by constructing dwellings without basements, building on fill material, or constructing the basements above the level of wetness. The wetness also can be overcome by installing tile drains around the foundations and providing a gravity outlet or another dependable outlet. Installing a drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or gravel, help to prevent the damage to local roads and streets caused by frost action.

The land capability classification is IIw. The woodland ordination symbol is 2W. The habitat type is TMC.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with

water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 143,000 acres in Marinette County, or about 16 percent of the land area, is prime farmland. This land is in scattered areas throughout the county. It is mainly in associations 1, 2, 3, 4, 6, and 10. These associations are described under the heading "General Soil Map Units." About 56,000 acres of this land is used for crops, mainly corn and alfalfa. The remaining acreage is woodland.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils as woodland; for crops and pasture; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Woodland Management and Productivity

George W. Alley, forester, Soil Conservation Service, helped prepare this section.

Before being cleared for agriculture, the entire land area of Marinette County was forested *(5)*. About 661,000 acres, or about 74 percent of the land area, was classified as commercial forest in 1983 *(6)*.

About 59 percent of the forested acreage is privately owned, and about 40 percent is owned by the county. Less than 1 percent is state owned.

In 1983, the composition of the commercial forest land by stand-size class was 21 percent sawtimber, 49 percent poletimber, and 30 percent seedlings and saplings. The composition of the forest land, by timber type, was 8.2 percent pine, 15.9 percent other conifers, 8.9 percent oak, 7.6 percent elm-ash, 20.4 percent maple-beech-birch, 37.5 percent aspen-white birch, and 1.5 percent nonstocked.

The growing stock of all the county forests in 1982 had a volume of 5,227,312 cords, an annual growth of 191,679 cords, and an annual removal of 132,492 cords. Sawtimber had a volume of 1,211,917,000 board feet, an annual growth of 55,003,000 board feet, and an annual removal of 42,357,000 board feet.

Forest fires are controlled by a well organized suppression system. The main management need is probably the removal of defective trees and the less valuable species. The need for improved forest management is greatest on privately owned land other than industrial forest holdings.

Many upland hardwood types have been converted to aspen and birch as a result of repeated logging, fires, and agricultural activities and the increased demand for pulpwood species (fig. 17).

Management of the woodland in Marinette County varies on the different kinds of soil. It should be governed by the tree species in the stand, the suitability of the soil to the species, and the landowner's objective. The best management alternatives are those that favor the hardwood species through a selection harvest or that favor aspen and birch through an even-aged approach. Even-aged management that favors pine, northern red oak, or sugar maple is desirable if the stand includes significant amounts of these species. Other management alternatives are those that favor

Figure 17.—Aspen pulpwood harvested in an area of Menominee loamy sand, 2 to 6 percent slopes.

northern whitecedar for the production of posts and piles and those that favor balsam fir as a pulpwood species.

Management should include controlling water erosion, planting trees where natural regeneration is unreliable, controlling vegetation that competes with natural or artificial regeneration, improving seedling survival, minimizing windthrow on the wetter sites, harvesting in a timely manner, controlling damage by insects and diseases, removing cull trees and other undesirable species, maintaining an optimum basal area, and excluding livestock, which can hinder the reproduction of trees. The main management concerns are described in the paragraphs that follow.

Water erosion can occur as a result of site preparation and following cutting operations where the soil is exposed along roads, skid trails, and landings. Burned areas are also subject to erosion. Water erosion is generally a hazard on forest land if the slope is 15 percent or more. Soils that are susceptible to erosion include the steeper Alpena, Emmert, Emmet, Keweenaw, Mancelona, Menahga, Menominee, Padus,

Sarona, and Shawano soils. Careful selection of sites for skid trails and roads during harvest helps to minimize erosion.

Soil wetness is the result of a high water table, flooding, or ponding. It causes seedling mortality, limits the use of equipment, results in the invasion or growth of undesirable plants following harvest, and increases the likelihood of windthrow by restricting the rooting depth of some tree species. Wetness is a problem in forested areas of poorly drained and very poorly drained soils, such as Arnheim, Brevort, Bruce, Deford, Ensley, Forada, Markey, Nahma, Pickford, Pinconning, Roscommon, and Seelyeville soils. Harvest is frequently limited to periods when the soil is frozen or the snow cover is thick. Wetness during the tree-planting season limits reforestation to natural regeneration or hand planting. Wetness also is a problem in spring and in other excessively wet periods on the somewhat poorly drained Allendale, Au Gres, Banat, Bonduel, Charlevoix, Gaastra, Iosco, Monico, Selkirk, Wainola, and Worcester soils.

Planting vigorous nursery stock on prepared ridges or on cradle-knolls is essential for the prevention of seedling mortality. Harvesting by shelter-wood or strip-cut methods helps to ensure natural regeneration of trees and minimizes windthrow of the remaining trees. The vegetation that competes with natural or artificial regeneration following harvest can be controlled by applications of suitable herbicides or by mechanical removal.

Water tends to pond in small swales between cradle-knolls in some areas of the somewhat poorly drained soils, such as Banat, Bonduel, Charlevoix, Gaastra, Iosco, Monico, Selkirk, Wainola, and Worcester soils. The seedling mortality rate can be high in the swales. Hand planting on the cradle-knolls or machine planting on prepared ridges may be needed if natural regeneration is unreliable.

Soil droughtiness can also cause seedling mortality. The steeper south- and west-facing slopes may be especially droughty because of high temperatures and evaporation on these sites. Droughtiness is a problem on Alpena, Au Gres, Croswell, Iosco, Karlin, Keweenaw, Mancelona, Manistee, Menahga, Rousseau, Sayner, Shawano, and Wainola soils and, to a lesser extent, on Ishpeming, Menominee, and Pence soils. Seedling survival during dry periods can be improved by planting vigorous nursery stock if natural regeneration is unreliable. Reinforcement planting may be needed. Containerized planting stock may be necessary on very dry sites.

Slope can limit the use of forestry equipment if it is 15 percent or more. Where the slope prevents the use of machinery, hand planting is required if natural regeneration is unreliable. Special harvesting systems may be needed where equipment cannot be operated safely on the steepest slopes.

Plant competition is a problem on most of the woodland in the county because soil productivity is so high that undesirable plants grow where openings are made in the tree canopy. Competition from undesirable plants can hinder or prevent regeneration of the more desirable species. It can be controlled by applications of suitable herbicides, by mechanical removal, or by selective cutting that maintains most of the tree canopy.

Tables 6 and 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. Table 6 lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic feet per acre per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 6, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special

precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in 50 years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production. Further information about these trees is available in the local office of the Soil Conservation Service.

Table 7 gives information about operating harvesting or thinning equipment in logging areas and on skid trails, log landings, and haul roads. Limitations are given for the most limiting season, and the preferred operating seasons are indicated. The *most limiting season* in Marinette County generally is spring or late fall. The *preferred operating season* is the period when harvesting or thinning causes the least amount of soil damage. This period generally is when the soil is not too wet or when the ground is frozen or partly frozen or has a thick snow cover.

In table 7 a rating of *slight* indicates that the use of conventional logging equipment is not restricted if normal logging methods are used. A rating of *moderate* indicates that the use of equipment is restricted because of one or more soil factors. If wetness is a limitation, high flotation equipment or special procedures may be needed to prevent the formation of ruts. A rating of *severe* indicates that the kind of equipment that can be used is seriously restricted.

Logging areas and skid trails include areas where some or all of the trees are being cut. Generally, equipment traffic is least intensive in the logging areas. Skid trails, which generally are within the logging area, are roads or trails over which the logs are dragged or hauled from the stump to a log landing.

Log landings are areas where logs are assembled for transportation. Wheeled equipment may be used more frequently in these areas than in any other areas affected by logging.

Haul roads are access roads leading from primary or surfaced roads to the logging areas. The haul roads serve as transportation routes for wheeled logging equipment and logging trucks. Generally, they are unpaved roads. Some are graveled.

Additional information about woodland management and productivity can be obtained from the Wisconsin Department of Natural Resources, the local office of the Soil Conservation Service, or the Cooperative Extension Service.

Forest Habitat Types

John Kotar, associate scientist, Department of Forestry, University of Wisconsin-Madison, helped prepare this section.

The information in this section is derived from the *Field Guide to Forest Habitat Types of Northern Wisconsin (9)*. The habitat type system is a natural classification system for forest communities and the sites on which they develop. It uses systematic interpretation of natural vegetation with emphasis on understory species. Its primary use is for assessment of the biological potential of forest sites for the management of various natural resources. Although soil map units do not coincide exactly with habitat types, strong correlations between them do exist. Therefore, habitat types can provide valuable interpretation of soil map units for forest resource management.

The field guide describes 17 upland habitat types, 8 of which occur in Marinette County. It also provides the following: (1) keys to habitat type identification, based on presence and absence of diagnostic understory species; (2) a description of each habitat type in terms of understory species composition, prevalent forest cover types (successional stages), and expected successional trends; and (3) a summary of management implications of each habitat type. This summary, in combination with various tables and diagrams, identifies those habitat types that are particularly suited for management of specific tree species. This information takes into account the potential influence of competing vegetation as well as the inherent site capability.

Habitat types have been determined for most map units in Marinette County. Where two habitat types are associated with a soil, they are identified as primary and secondary. The primary habitat type is one that is most common on the map unit. The secondary habitat type is less common. Habitat types are identified at the end of the descriptions in the section "Detailed Soil Map Units." The following paragraphs briefly describe the habitat types in the county.

AFD—Acer-Fagus/Dryopteris habitat type. This habitat type has a presumed climax overstory dominated by sugar maple, American beech, and eastern hemlock. Yellow birch is an important associate.

Ground vegetation on this habitat type is generally sparse. The most commonly encountered species are spinulose shield fern, wild lily-of-the-valley, and beech seedlings. Less frequent but characteristic species are Indian cucumber root and beechdrops.

This type has moderate to high potential productivity for most species of northern hardwoods and aspen. Potential productivity for red pine is also high if adequate measures are taken to control hardwood competition.

ATD—Acer-Tsuga/Dryopteris habitat type. The presumed climax overstory on this habitat type is dominated by sugar maple, eastern hemlock, and yellow birch.

Although most hardwoods grow well on this habitat type if they can become established, sugar maple tends to dominate young as well as mature stands. For this reason management for intolerant and midtolerant species on this habitat type is difficult.

The understory is generally poorly developed, the shrub layer is normally absent, and ground vegetation is sparse. The most conspicuous species are spinulose shield fern, lady fern, wild lily-of-the-valley, and sugar maple seedlings.

ATM—Acer-Tsuga/Maianthemum habitat type. The presumed climax overstory on this habitat type is dominated by eastern hemlock, sugar maple, and yellow birch. Successional stages can be very diverse, however, because many native tree species grow well on this habitat type. Management options are most often dictated by the conditions of current stands rather than by site limitations.

The understory species diversity is relatively low. The most common species are wild lily-of-the-valley, wild sarsaparilla, large-leaved aster, and beaked hazelnut.

AQV—Acer-Quercus/Vaccinium habitat type. This habitat type is on some soils in the northern half of the county; but in the southern half, similar but presently undefined habitat types occur on the same soils. The presumed climax overstory on this habitat type is dominated by red maple and northern red oak, probably with common occurrence of eastern white pine. Present stands are almost entirely dominated by early-successional species, such as aspen, white birch, jack

pine, red pine, and eastern white pine.

Understory vegetation consists primarily of beaked hazelnut, bracken fern, blueberries, wild lily-of-the-valley, and large-leaved aster.

This type is suitable for management of all three native species of pine, aspen, and white birch. Among the hardwoods, only northern red oak and red maple are suitable for fiber production or wildlife cover.

AQVib—Acer-Quercus/Viburnum habitat type. The potential climax species dominant on this habitat type is sugar maple. The succession to sugar maple on logged-over sites, however, is less rapid than on other habitat types where this species is capable of growing. Present successional stands on AQVib are most often dominated by mixtures of northern red oak and red maple. Mixtures of aspen, white birch, and eastern white pine are also common. Productivity potential is very high for eastern white pine and red pine; high for northern red oak, red maple, white ash, and American basswood; and moderate to low for sugar maple.

Characteristic understory species are maple-leaved viburnum, witch hazel, and often pointed-leaved tick trefoil. Other common species include beaked hazelnut, hog peanut, large-leaved aster, and bracken fern.

AViO—Acer/Viola-Osmorhiza habitat type. The presumed climax overstory of this habitat type is dominated by sugar maple.

Early and mid-successional stages may have a generous mixture of several hardwood species, especially American basswood, white ash, yellow birch, or northern red oak. With the exception of eastern hemlock, conifers are generally absent from this habitat type. Growth potential for all native hardwoods is very high.

Understory vegetation on this type is usually well developed and species rich. The most characteristic species are sweet cicely, trillium, yellow violets, lady fern, spinulose shield fern, hairy and false Solomon's seal, jack-in-the-pulpit, and blue cohosh.

PMV—Pinus/Maianthemum-Vaccinium habitat type. This habitat type is on some soils in the northern half of the county; but in the southern half, similar but presently undefined habitat types occur on the same soils. This habitat type has a presumed climax overstory dominated by eastern white pine with balsam fir, white spruce, red maple, and northern red oak constituting a second canopy.

Present stands are largely dominated by mixtures of jack pine, red pine, eastern white pine, aspen, red maple, or northern red oak. The understory is similar to that described for the AQV habitat type, but the herb layer is generally better developed.

This type is considered optimal for red pine or eastern white pine management, because their yields are nearly as high as on the more mesic types. Potential competition from hardwood species, however, is much less. Except for northern red oak, hardwood management is suitable only for fiber production or for wildlife habitat. Potential for aspen also is very high.

TMC—Tsuga/Maianthemum-Coptis habitat type. The presumed climax overstory on this habitat type consists of eastern hemlock, yellow birch, red maple, and sugar maple.

This type occurs most commonly in low areas within many of the other types and as a transition type from lake shores and swamps to uplands. The presence of conifers (balsam fir, northern whitecedar, and white spruce) is another characteristic of this type. Characteristic understory species are wild lily-of-the-valley, goldthread, bunchberry, clubmosses, and yellow beadlily. Blueberries, bracken fern, and large-leaved aster are sometimes abundant.

Eastern hemlock and yellow birch have the highest potential for management from a forestry point of view. Northern whitecedar, balsam fir, and white spruce are suitable as wildlife habitat or as a source of fiber production. Although sugar maple is reproducing on this type, its growth and form are poor. Where this type occurs on the better drained topographic positions, it is well suited for eastern white pine management.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1985, about 187,000 acres of Marinette County was used for farms, according to 1986 Wisconsin agricultural statistics. Of this total, 18,600 acres was

used for corn for grain, 9,800 acres for corn for silage, 28,900 acres for alfalfa hay, 5,100 acres for all other hay species, and 7,300 acres for oats. The balance of the acreage was used for all other crops, pasture, and woodlots.

The potential for increased food production in Marinette County is good. About 200,000 acres of potentially good cropland is used as woodland. In addition to the reserve capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all of the cropland in the county. The use of this soil survey can greatly facilitate the application of such technology.

Water erosion is the major soil problem on about 55 percent of the cropland and pasture in the county. It is a hazard on all soils having a slope of about 2 percent or more.

Loss of the surface layer through erosion is damaging in at least two ways. First, productivity is reduced as the surface layer is lost and part of the subsurface layer or subsoil is incorporated into the plow layer. The surface layer contains more organic matter than other parts of the soil. Erosion is especially damaging on soils that have a clayey subsoil, such as Hibbing soils, and on soils that are only shallow or moderately deep over bedrock, such as Cunard and Summerville soils. Erosion also reduces productivity on soils that tend to be droughty, such as Menahga, Rousseau, and Shawano soils. Second, erosion can result in the sedimentation of streams. Controlling erosion minimizes this pollution and improves water quality for municipal use, for recreation, and for fish and wildlife.

Erosion control measures provide protective ground cover, reduce the runoff rate, and increase the rate of water infiltration. A conservation cropping system that keeps plant cover on the surface for extended periods can hold soil losses to an amount that does not reduce the productive capacity of the soils. On livestock farms, where pasture and hay are needed, including legumes and grasses in the cropping sequence not only provides nitrogen and improves tilth but also reduces the hazard of erosion.

Conservation tillage systems that leave protective amounts of crop residue on the surface, such as no-till, till plant, chisel planting, and disc planting, help to increase infiltration and reduce runoff and erosion. These systems can be adapted to most soils in the county.

Soil blowing is a hazard on the sandy soils, such as Mancelona, Menahga, Rousseau, and Shawano soils. It can result in soil loss and can damage young crops in a few hours if winds are strong and the soils are dry and are not protected by vegetation or surface mulch. Maintaining a cover of plants or surface mulch minimizes soil blowing. Windbreaks are also effective in controlling soil blowing.

Information about the design of measures that control erosion and soil blowing on each soil in the county can be obtained at the local office of the Soil Conservation Service.

Soil drainage is the major management need on about one-third of the acreage used for crops and pasture in the county. Some soils are naturally so wet that they generally cannot be used for the crops commonly grown in the county unless they are drained. These include the poorly drained and very poorly drained Brevort, Bruce, Deford, Ensley, Forada, Nahma, Pickford, Pinconning, and Roscommon soils.

Unless drained, the somewhat poorly drained soils also are so wet that crops are damaged during most years. The Allendale, Au Gres, Banat, Bonduel, Charlevoix, Gaastra, Iosco, Monico, Selkirk, Wainola, and Worcester soils are somewhat poorly drained.

The design of both surface and subsurface drainage systems varies, depending on soil properties and site conditions. A combination of surface and subsurface drains is needed in most areas of the poorly drained and very poorly drained soils used for intensive row cropping. Diversions are needed in some areas to remove runoff from the adjacent fields. In soils that are underlain by stratified silt and very fine sand or fine sand, special covering is needed over the drainage tile. This covering helps to keep substratum material from filling and clogging the tile.

If organic soils are used as cropland, special drainage measures are necessary. These soils oxidize and subside when water is removed from their pores and the pores are filled with air. Drainage systems that control the depth and period of drainage are needed. Keeping the water table at the level required for crop growth during the growing season and raising it to the surface during other parts of the year minimize the oxidation and subsidence of these soils.

Further information about the design of drainage systems can be obtained at the local office of the Soil Conservation Service.

Soil fertility is naturally low or medium in most of the cultivated or pastured upland soils in the county. Fertility can be improved by using cropping systems that provide for regular additions of organic matter. Applying barnyard manure, plowing under a green crop, returning crop residue to the soil, and adding

commercial fertilizer are beneficial practices. Most commonly grown crops respond well to commercial fertilizer. All acid soils require applications of ground limestone to raise the pH level sufficiently for the production of alfalfa and other crops that grow best on nearly neutral soils. On all soils, additions of lime or fertilizer should be based on the results of soil tests, the needs of the crop, and the desired level of yields. The Cooperative Extension Service can help in determining the kind and amounts of fertilizer and lime to be applied.

Soil tilth is an important factor affecting the germination of seeds, the emergence of seedlings, and the infiltration of water into the soils. Soils with good tilth are granular and porous.

Tilling or grazing during wet periods can result in poor tilth. Most of the soils used for crops in the county have a loam or sandy loam surface layer that is light in color and has a low or moderate content of organic matter. Generally, the structure of such soils is weak or moderate. If the soils are bare, a surface crust can form during periods of heavy rainfall. This crust is hard when dry and is nearly impervious to water. It restricts the growth of small seeded plants, which have difficulty in emerging through it. Once the crust forms, it reduces infiltration and increases the runoff rate and the hazard of erosion. Regular additions of crop residue or manure can help to improve soil structure and tilth and minimize crusting.

Field crops suited to most of the soils and the climate of the county include corn, which is the most commonly grown row crop, and oats, the most common close-grown crop. A limited acreage is used for barley or wheat.

The most commonly grown hay and pasture species are mixtures of alfalfa and bromegrass and mixtures of red clover and timothy. Bluegrass is the most common native pasture species.

Specialty crops grown commercially in the county are vegetables and small fruits. The most common vegetables are sweet corn, snap beans, and potatoes. A small acreage is used for strawberries and cucumbers. Most of the well drained soils in the county are suited to these crops. Soils in low areas where frost is frequent and air drainage is poor generally are poorly suited to early vegetables, small fruits, and orchards. More information about growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 8. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered *(8)*.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 8 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops *(15)*. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped

at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Windbreaks and Environmental Plantings

Most of the windbreaks in Marinette County are used to protect farmsteads and rural homes. The commonly planted tree species are red pine, white spruce, Norway spruce, and eastern white pine. Generally, they are planted on the north or west sides of the protected areas, or on both sides.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are predicted to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service, the Wisconsin Department of Natural Resources, or the Cooperative Extension Service or from a commercial nursery.

Recreation

Marinette County offers outdoor recreation opportunities for many people. The system of county parks, extensive county woodland, and numerous lakes and streams provide areas for many outdoor recreational activities.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines.

The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Thomas P. Thrall, biologist, Soil Conservation Service, helped prepare this section.

Marinette County has an abundant and diverse wildlife population. It sustains species suited to wilderness areas as well as those suited to farmland areas. The wetlands, which are scattered throughout the county, play a large role in the diversity of habitat and are important to several species.

Of the total land area in Marinette County, about 74 percent is classed as commercial forest. Much of this land is owned by the county. The northern two-thirds of the county is almost entirely forested and is sparsely settled. Some wildlife species in this wilderness setting include black bear, bobcat, porcupine, snowshoe hare, red squirrel, bald eagle, white-tailed deer, and ruffed grouse.

Several wildlife species are throughout the county. Otter, beaver, muskrat, and mink can be found in stream riparian habitats. Raccoon, skunk, red fox, and coyote are in forested areas as well as in agricultural areas.

White-tailed deer and ruffed grouse are two major game species that are found countywide in the woody cover. Of particular importance to these species is the aspen cover type. Woodcock are in cut-over aspen and brushy stream bottoms throughout the county.

Most of the farming is in the southern third of the county. Typical species include cottontail rabbit, white-tailed deer, raccoon, skunk, red-tailed hawk, and red fox.

Soil plays a role in land use and in tree species present and, therefore, in wildlife habitat. Beyond this, habitat management practices can be used to maintain or improve habitat for desired wildlife species. Of major importance is the maintenance of the aspen cover type, which is so important to white-tailed deer and ruffed grouse. Maintaining the aspen cover includes clearcutting blocks of aspen in a way that the stands

regenerate as a result of the cut. Cutting aspen in small blocks ranging from 10 to 40 acres, rather than all at once, ensures that different age classes remain to provide optimum habitat for ruffed grouse.

Maintaining 2 or 3 den trees and nut-producing trees per acre in hardwood during a timber harvest helps to maintain habitat for squirrels, raccoons, and several bird species. Creating or maintaining openings in timber stands improves habitat for white-tailed deer and ruffed grouse.

In agricultural areas, leaving ¼- to ½-acre foodplots of corn adjacent to winter cover areas benefits turkeys, white-tailed deer, and song birds. Creating a shrubby edge along woodlots by planting shrubs or cutting back mature trees improves habitat for white-tailed deer and ruffed grouse. Installing ponds may improve waterfowl habitat if grassy nesting cover is available nearby.

Although there is not a clear-cut division of wildlife populations based on soil map units, certain general statements can be made. The paragraphs that follow specify the kinds of wildlife and wildlife habitat in areas of the associations described under the heading "General Soil Map Units."

Most of the Emmet-Charlevoix association is cropland. Corn and alfalfa are the principal crops. Stands of timber, primarily lowland hardwoods, are also in areas of this association. These woodlands provide habitat for gray squirrel and ruffed grouse. The edge effect created by the combination of woodland and cropland provides favorable habitat for cottontail rabbits, red fox, raccoons, and white-tailed deer. Muskrats and other furbearers can be found in the riparian habitat associated with streams. A few pheasants live along the grassy marsh areas close to good cropland.

Menominee-Emmet, Cunard-Emmet, Mancelona-Emmet-Menahga, and Seelyeville-Markey-Emmet associations have a diversity of cover types and land use. This diversity results in excellent wildlife habitat. Wild turkeys migrating from Upper Michigan have been found in the Mancelona-Emmet-Menahga and Seelyeville-Markey-Emmet associations along the Menominee River. Scattered farms offer some habitat diversity and may be very important for wild turkeys, especially in winter.

Swamps are important to many species, including white-tailed deer, bobcat, and snowshoe hare. Aspen is abundant in the area and provides important habitat for ruffed grouse and white-tailed deer.

Most areas of the Sarona-Keweenaw association are used as woodland. Upland hardwoods grow well in this association. The stands are mostly mature and thus provide less food and cover for white-tailed deer and ruffed grouse than in the other associations. The results are lower populations of these species. The habitat is important for many species of song birds. To encourage greater diversity of wildlife in this association, it is especially important to create forest openings and to seed these areas with herbaceous plants and grasses. Logging roads, log landings, and old camp sites can also be seeded. Openings are particularly valuable near stands of aspen.

The Wainola-Deford association contains the state-owned Peshtigo Harbor Wildlife Area, the primary area for waterfowl reproduction in the county. Blue-winged teal and mallard are common grassland nesting species, and wood ducks nest in the lowland hardwoods in this association. This association is a good area for white-tailed deer and ruffed grouse.

The Menahga association is mostly wooded with a good mix of northern pin oak, aspen, and jack pine. It is a good area for white-tailed deer and ruffed grouse. Three major deer yards, the Eagle deer yard, Long Swamp deer yard, and the Brazeau deer yard, are in this association. To encourage greater diversity of wildlife in this association, it is especially important to create forest openings and to seed these areas with herbaceous plants and grasses. Logging roads, log landings, and old camp sites can also be seeded. Openings are particularly valuable near stands of aspen.

The Pence-Padus association has mostly aspen-birch timber type in the younger stands. Wetlands are scattered throughout, and red pine plantations are also present. Because of the aspen, this association is a good area for white-tailed deer and ruffed grouse.

The Ishpeming-Michigamme-Rock outcrop association is nearly all wooded and has many rock outcrops. This association has a wide variety of timber types, primarily aspen and upland hardwoods. It contains a wide variety of wildlife and is another good area for ruffed grouse and white-tailed deer. The rock outcrops provide good dens for black bears. As with the other heavily wooded soil associations, creating forest openings and planting herbaceous plants and grasses are important.

The Seelyeville-Markey association is almost exclusively cedar swamps and wetlands of balsam fir, white spruce, and black spruce. It is an important area for white-tailed deer, bobcat, snowshoe hare, and black bear.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and

distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian olive, autumn olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild

turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Additional information on habitat management for different species of wildlife can be obtained from the local office of the Soil Conservation Service.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer;

stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 13 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the

water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel or stones, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly

mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or of organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity in the root zone. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone and by soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce water erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

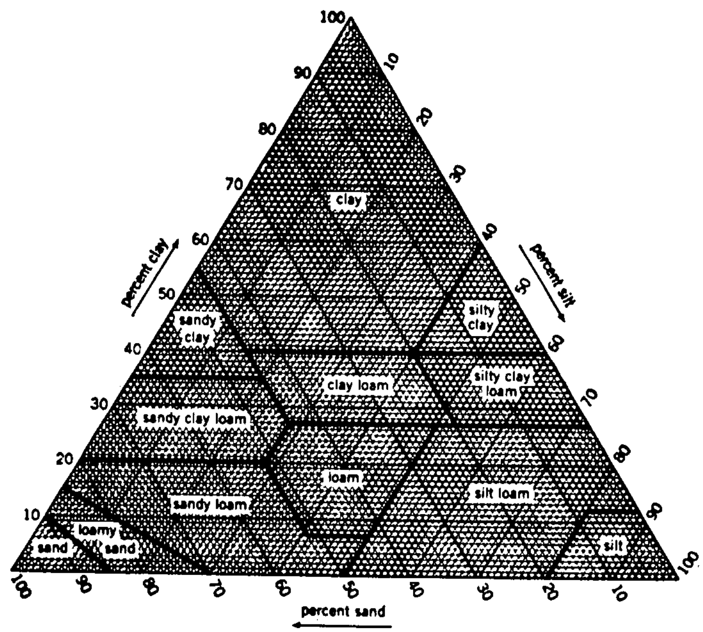

Figure 18.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 18). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and

clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available

water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 18, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence results from either desiccation and shrinkage or oxidation of organic material, or both, following

drainage. Subsidence takes place gradually, usually over a period of several years. Table 18 shows the expected total subsidence, which usually is a result of oxidation.

Not shown in the table is subsidence caused by an imposed surface load or by the withdrawal of ground water throughout an extensive area as a result of lowering the water table.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Wisconsin Department of Transportation, Division of Highways and Transportation Facilities.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(16)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boralf (*Bor*, meaning cool, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Eutroboralfs (*Eutro*, meaning high base saturation, plus *boralf*, the suborder of the Alfisols that formed in cool climates).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Eutroboralfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-loamy, mixed Typic Eutroboralfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (14)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (16)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Allendale Series

The Allendale series consists of deep, somewhat poorly drained soils in glacial lake basins and on

outwash plains. These soils formed in sandy outwash deposits and in the underlying clayey lacustrine deposits. Permeability is rapid in the sandy upper part of the profile and slow in the lower clayey deposits. Slope ranges from 0 to 3 percent.

Typical pedon of Allendale loamy sand, 0 to 3 percent slopes, approximately 1,400 feet south and 2,600 feet east of the northwest corner of sec. 8, T. 35 N., R. 18 E.

A—0 to 3 inches; very dark gray (10YR 3/1) loamy sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; common fibrous roots; very strongly acid; abrupt wavy boundary.

E—3 to 5 inches; brown (7.5YR 5/2) loamy sand; weak thin platy structure; very friable; many fine roots; very strongly acid; abrupt wavy boundary.

Bs1—5 to 10 inches; reddish brown (5YR 5/4) loamy sand; few fine prominent light yellowish brown (10YR 6/4) mottles; weak medium subangular blocky structure; very friable; few fine roots; very strongly acid; clear wavy boundary.

Bs2—10 to 19 inches; yellowish red (5YR 5/6) sand; common medium distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; few fine roots; medium acid; abrupt smooth boundary.

E′—19 to 27 inches; reddish brown (5YR 4/3) loamy sand; many medium prominent reddish yellow (5YR 6/8) mottles; weak fine subangular blocky structure; very friable; slightly acid; abrupt smooth boundary.

2B/E—27 to 31 inches; about 80 percent reddish brown (5YR 4/4) silty clay (2Bt); few fine prominent yellowish brown (10YR 5/6) mottles; weak fine angular blocky structure; friable; about 20 percent interfingering of reddish brown (5YR 5/3) silty clay (2E); common faint reddish brown (5YR 4/4) clay films on faces of peds; slightly acid; clear irregular boundary.

2C—31 to 60 inches; reddish brown (5YR 5/4) silty clay; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium angular blocky fragments; friable; neutral.

The thickness of the sandy mantle and the depth to clayey deposits range from 20 to 40 inches. The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 1 or 2. It is sand, fine sand, or loamy sand. The Bs1 and Bs2 horizons have hue of 5YR or 7.5YR, value of 2 to 5, and chroma of 2 to 6. They are loamy sand, sand, or fine sand. The E′ horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 to 8. It is sand, fine sand, or loamy sand. The 2Bt part of the 2B/E horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 2 to 4. It is clay or silty clay. The 2E part has hue of 7.5YR or 5YR, value of 4 to 7, and chroma of 2 or 3. The 2C horizon has hue of 2.5YR or 5YR, value of 5 or 6, and chroma of 2 to 4. It is clay or silty clay.

Alpena Series

The Alpena series consists of deep, excessively drained, very rapidly permeable soils on outwash plains, eskers, and kames. These soils formed in thin deposits of loamy material and in the underlying stratified, calcareous sandy and gravelly outwash. Slope ranges from 6 to 35 percent.

The Alpena soils in Marinette County have a thinner dark surface layer than is defined as the range for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Typical pedon of Alpena gravelly sandy loam, 12 to 35 percent slopes, approximately 2,110 feet south and 460 feet west of the northeast corner of sec. 11, T. 32 N., R. 21 E.

A—0 to 3 inches; black (10YR 2/1) gravelly sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many very fine fibrous roots; about 20 percent gravel and 5 percent cobbles; mildly alkaline; abrupt wavy boundary.

Bw—3 to 8 inches; brown (7.5YR 4/4) gravelly sandy loam; weak fine and medium subangular blocky structure; very friable; many fine fibrous roots; about 20 percent gravel and 5 percent cobbles; mildly alkaline; abrupt wavy boundary.

2C—8 to 60 inches; yellowish brown (10YR 5/4), stratified sand and very gravelly sand; single grain; loose; about 35 percent gravel and 5 percent cobbles; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 4 to 10 inches. Typically, the content of gravel and cobbles is 10 to 25 percent, but it ranges to as much as 50 percent.

The A horizon has value of 2 or 3 and chroma of 1 or 2. Some pedons have an Ap horizon. This horizon has value of 2 or 3. The Bw horizon has value of 4 or 5 and chroma of 4 to 6. It is gravelly loamy sand, gravelly sandy loam, or loamy sand. The 2C horizon has value of 5 to 7 and chroma of 3 or 4.

Arnheim Series

The Arnheim series consists of deep, poorly drained, moderately permeable soils on flood plains. These soils formed in silty and sandy alluvial deposits. Slope is 0 to 1 percent.

Typical pedon of Arnheim silt loam, 0 to 1 percent slopes, approximately 750 feet east and 1,050 feet north of the southwest corner of sec. 3, T. 33 N., R. 21 E.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; many fibrous roots; neutral; abrupt smooth boundary.

Cg1—3 to 9 inches; dark grayish brown (10YR 4/2) silt loam; common medium prominent strong brown (7.5YR 5/6) mottles; moderate fine granular structure; very friable; many fibrous roots; neutral; abrupt smooth boundary.

Cg2—9 to 12 inches; grayish brown (10YR 5/2) silt loam; common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; very friable; few fine roots; neutral; abrupt smooth boundary.

Cg3—12 to 17 inches; grayish brown (10YR 5/2) silt loam; many coarse prominent strong brown (7.5YR 5/6) mottles; moderate thick platy structure; friable; few fine roots; neutral; abrupt smooth boundary.

C1—17 to 29 inches; reddish brown (5YR 4/4) silt loam; many medium prominent brown (7.5YR 5/2) and strong brown (7.5YR 5/6) mottles; moderate medium platy structure parting to moderate fine subangular blocky; friable; neutral; abrupt smooth boundary.

C2—29 to 40 inches; variegated brown (7.5YR 5/2 and 5/4) and reddish yellow (7.5YR 6/6) loamy fine sand; weak medium subangular blocky structure; very friable; neutral; abrupt smooth boundary.

C3—40 to 60 inches; yellowish brown (10YR 5/4) sand; many medium distinct brownish yellow (10YR 6/6) mottles; single grain; loose; neutral.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4. The Cg horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 to 6; and chroma of 1 or 2. The C horizon has hue of 10YR, 7.5YR, or 5YR; value of 3 to 5; and chroma of 2 to 6. The Cg and C horizons are silt loam, loamy very fine sand, or loamy fine sand. Below a depth of about 40 inches, the C horizon is loamy sand or sand. It contains strata of silt loam or silty clay loam in some pedons.

Au Gres Series

The Au Gres series consists of deep, somewhat poorly drained, rapidly permeable soils on outwash plains (fig. 19). These soils formed in sandy outwash deposits. Slope ranges from 0 to 3 percent.

Typical pedon of Au Gres loamy sand, 0 to 3 percent slopes, approximately 5 feet south and 1,450 feet east of the northwest corner of sec. 19, T. 30 N., R. 23 E.

Oe—2 inches to 0; black (10YR 2/1) forest litter.

A—0 to 3 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; many fine roots; many sand grains without organic coatings; very strongly acid; abrupt smooth boundary.

E—3 to 7 inches; light brownish gray (10YR 6/2) sand, light gray (10YR 7/1) dry; few fine prominent brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; very friable; common fine roots; strongly acid; abrupt smooth boundary.

Bh—7 to 10 inches; dark reddish brown (5YR 3/3) sand; common medium prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; very friable; common fine roots; about 20 percent ortstein fragments; strongly acid; clear wavy boundary.

Bs—10 to 18 inches; reddish brown (5YR 4/4) sand; common medium prominent brown (7.5YR 5/2) and strong brown (7.5YR 5/8) mottles; weak medium and coarse subangular blocky structure; very friable; common fine roots; about 25 percent ortstein fragments; strongly acid; irregular wavy boundary.

BC—18 to 29 inches; strong brown (7.5YR 5/6) sand; many coarse prominent yellowish brown (10YR 5/8) and brown (7.5YR 5/2) mottles; weak medium subangular blocky structure; very friable; weak discontinuous cementation of sand grains in upper 6 inches; medium acid; clear wavy boundary.

C—29 to 60 inches; strong brown (7.5YR 5/6) sand; common medium and coarse distinct yellowish red (5YR 5/8) mottles; single grain; loose; medium acid.

The thickness of the solum ranges from 20 to 36 inches. In some pedons the content of gravel is as much as 10 percent. The content of ortstein fragments ranges from nearly none to about 30 percent in the Bh and Bs horizons.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 1 or 2. The Bh horizon has hue of

7.5YR or 5YR, value of 2 to 4, and chroma of 2 or 3. It is commonly sand but is loamy sand in some pedons. The Bs horizon has hue of 7.5YR or 5YR and value and chroma of 4 to 6. The BC horizon has value of 5 or 6 and chroma of 4 to 6. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 2 to 6.

Banat Series

The Banat series consists of deep, somewhat poorly drained soils on outwash plains and stream terraces. These soils formed in loamy deposits and in the underlying calcareous sandy and gravelly deposits. Permeability is moderate in the loamy upper part of the subsoil and very rapid in the substratum. Slope ranges from 0 to 3 percent.

Typical pedon of Banat sandy loam, 0 to 3 percent slopes, approximately 2,540 feet north and 2,540 feet west of the southeast corner of sec. 26, T. 34 N., R. 20 E.

A—0 to 9 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; very friable; many medium roots; about 5 percent gravel and 2 percent cobbles; neutral; abrupt smooth boundary.

E—9 to 13 inches; brown (10YR 5/3) sandy loam; many coarse distinct brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; very friable; many medium roots; about 5 percent gravel and 2 percent cobbles; neutral; abrupt wavy boundary.

Bt1—13 to 18 inches; strong brown (7.5YR 5/6) gravelly sandy loam; many medium prominent brownish yellow (10YR 6/8) and common fine prominent grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; few fine roots; common strong brown (7.5YR 5/6) clay films on faces of peds; about 15 percent gravel and 2 percent cobbles; neutral; abrupt wavy boundary.

2Bt2—18 to 23 inches; brown (7.5YR 5/4) very gravelly sandy loam; many coarse prominent brownish yellow (10YR 6/8) and few fine distinct pinkish gray (7.5YR 6/2) mottles; weak fine subangular blocky structure; very friable; few brown (7.5YR 4/4) clay films on pebbles; about 50 percent gravel; mildly alkaline; clear wavy boundary.

2Bt3—23 to 27 inches; yellowish brown (10YR 5/4) very gravelly loamy sand; many medium distinct brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; very friable; about 55 percent gravel; mildly alkaline; abrupt smooth boundary.

2C—27 to 60 inches; yellowish brown (10YR 5/4) very gravelly sand; few medium distinct yellowish brown (10YR 5/6) mottles; single grain; loose; strongly effervescent; about 55 percent gravel; mildly alkaline.

The thickness of the solum ranges from 18 to 36 inches. The content of gravel ranges from 0 to 15 percent in the A, E, and Bt1 horizons and from 35 to 65 percent in the 2Bt2, 2Bt3, and 2C horizons. The content of rock fragments more than 3 inches in diameter ranges from 0 to 5 percent throughout the profile.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. The E horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. The Bt1 horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is loam, fine sandy loam, sandy loam, or the gravelly analogs of these textures. The 2Bt2 horizon has colors similar to those of the Bt1 horizon. It is very gravelly loam, very gravelly fine sandy loam, or very gravelly sandy loam. The 2Bt3 horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 6. The 2C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 8. It is very gravelly coarse sand, very gravelly sand, extremely gravelly coarse sand, or extremely gravelly sand.

Bonduel Series

The Bonduel series consists of moderately deep, somewhat poorly drained soils on ground moraines. These soils are moderately permeable. They formed in loamy and silty deposits underlain by dolomite. Slope ranges from 0 to 3 percent.

Typical pedon of Bonduel loam, 0 to 3 percent slopes, approximately 80 feet north and 1,520 feet west of the southeast corner of sec. 17, T. 30 N., R. 22 E.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; few fine fibrous roots; neutral; abrupt smooth boundary.

BE—6 to 8 inches; brown (7.5YR 5/4) loam; common fine prominent reddish gray (5YR 5/2) mottles; moderate fine subangular blocky structure; very friable; few fine fibrous roots; common very dark grayish brown (10YR 3/2) earthworm casts; about 3 percent gravel; mildly alkaline; abrupt wavy boundary.

Bt—8 to 15 inches; reddish brown (5YR 4/4) loam; common medium distinct reddish gray (5YR 5/2) and common fine prominent yellowish red (5YR 5/8)

mottles; moderate fine and medium subangular blocky structure; very friable; few fine fibrous roots; common very dark grayish brown (10YR 3/2) earthworm casts; common faint reddish brown (5YR 5/4) clay films on faces of peds; about 8 percent gravel; mildly alkaline; abrupt wavy boundary.

BC—15 to 20 inches; brown (7.5YR 5/4) loam; common medium prominent reddish gray (5YR 5/2) and common medium prominent yellowish red (5YR 5/8) mottles; weak fine subangular blocky structure; very friable; about 7 percent gravel; mildly alkaline; abrupt wavy boundary.

C—20 to 28 inches; light brown (7.5YR 6/4) fine sandy loam; common medium prominent brownish yellow (10YR 6/6) and few fine prominent reddish gray (5YR 5/2) mottles; moderate fine and medium subangular blocky structure; friable; common medium distinct pinkish gray (7.5YR 7/2) soft lime accumulations; about 7 percent gravel; mildly alkaline; abrupt smooth boundary.

2R—28 inches; dolomite.

The thickness of the solum ranges from 20 to 36 inches. The depth to dolomite ranges from 20 to 40 inches. The content of gravel, cobbles, and channers ranges from 0 to 5 percent in the upper part of the solum and from 5 to 20 percent in the lower part.

The Ap horizon has value of 2 to 4 and chroma of 1 to 3. Some pedons have an A horizon. This horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Some pedons have an E horizon. This horizon has hue of 10YR, value of 4 to 6, and chroma of 2 or 3. It is loam or silt loam. The Bt horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. It is loam, silt loam, or sandy clay loam. The BC horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. It is sandy loam, loam, or fine sandy loam. The C horizon is loam, fine sandy loam, or sandy loam. Some pedons do not have a C horizon.

Brevort Series

The Brevort series consists of deep, poorly drained and very poorly drained soils on ground moraines and outwash plains. These soils formed in a thin layer of muck over sandy deposits and in the underlying loamy till. Permeability is rapid in the sandy upper part of the profile and moderate in the loamy lower part of the substratum. Slope ranges from 0 to 2 percent.

Typical pedon of Brevort muck, 0 to 2 percent slopes, approximately 1,460 feet south and 860 feet east of the northwest corner of sec. 1, T. 29 N., R. 22 E.

Oa—0 to 7 inches; black (10YR 2/1), broken face and rubbed, sapric material; about 15 percent fiber, less than 5 percent rubbed; weak fine subangular blocky structure; very friable; common roots; neutral; abrupt smooth boundary.

A—7 to 14 inches; very dark gray (N 3/0) loamy fine sand, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; very friable; few roots; about 15 percent organic matter content; neutral; abrupt smooth boundary.

Cg—14 to 15 inches; dark gray (10YR 4/1) fine sand; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; neutral; abrupt smooth boundary.

C1—15 to 39 inches; brown (10YR 5/3) fine sand; many medium distinct gray (10YR 5/1) and few fine distinct yellowish brown (10YR 5/6) mottles; single grain; very friable; neutral; abrupt wavy boundary.

2C2—39 to 60 inches; reddish gray (5YR 5/2) and brown (7.5YR 5/4) sandy loam; common coarse prominent strong brown (7.5YR 5/8) mottles; massive; friable; strongly effervescent; about 8 percent gravel; moderately alkaline.

The thickness of the sandy mantle, the depth to till, and the depth to free carbonates range from 20 to 40 inches. The content of gravel ranges from 0 to 5 percent in the sandy layers. The content of gravel and cobbles ranges from 0 to 10 percent in the underlying till.

The thickness of the muck layer ranges from 0 to 8 inches. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. It is loamy fine sand or mucky loamy fine sand. The Cg horizon has value of 4 to 6 and chroma of 1 or 2. It is fine sand, sand, or loamy sand. The C1 horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is fine sand or sand. The 2C2 horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is fine sandy loam, sandy loam, or loam.

Bruce Series

The Bruce series consists of deep, poorly drained and very poorly drained, moderately slowly permeable soils on ground moraines, on outwash plains, and in glacial lake basins. These soils formed in loamy deposits and in the underlying stratified silty and sandy

deposits. Slope ranges from 0 to 2 percent.

The Bruce soils in Marinette County have redder hue in the B horizon and have a thinner Bg horizon than is defined as the range for the series. Also, they do not have mottles or matrix colors with chroma of 2 in the control section. These differences, however, do not alter the usefulness or behavior of the soils.

Typical pedon of Bruce fine sandy loam, 0 to 2 percent slopes, approximately 50 feet south and 2,200 feet east of the northwest corner of sec. 23, T. 37 N., R. 18 E.

A—0 to 7 inches; very dark gray (10YR 3/1) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; common fine roots; mildly alkaline; abrupt smooth boundary.

Bg—7 to 13 inches; grayish brown (10YR 5/2) fine sandy loam; common medium prominent brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; very friable; few fine roots; neutral; abrupt wavy boundary.

2Bw—13 to 22 inches; brown (7.5YR 5/4) silty clay loam; common medium prominent strong brown (7.5YR 5/8) and common fine prominent grayish brown (10YR 5/2) mottles; moderate fine and medium subangular blocky structure; friable; mildly alkaline; abrupt smooth boundary.

2C1—22 to 25 inches; reddish brown (5YR 5/4) silty clay loam; moderate medium prominent brown (10YR 5/3) mottles; tends to part along horizontal cleavage planes inherited from parent material; friable; mildly alkaline; abrupt smooth boundary.

3C2—25 to 60 inches; reddish brown (5YR 5/3), stratified silt and very fine sand; common medium prominent yellowish brown (10YR 5/8) mottles; tends to part along horizontal cleavage planes inherited from parent material; very friable; mildly alkaline.

The thickness of the solum ranges from 18 to 26 inches. The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bg horizon has hue of 10YR, 7.5YR, or 5YR; value of 4 to 6; and chroma of 1 or 2. It is fine sandy loam, very fine sandy loam, or silt loam. The 2Bw horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. Texture of the B horizon is variable within short horizontal distances but commonly is silty clay loam or silt loam. It is loam or fine sandy loam in some pedons. The 2C1 and 3C2 horizons have hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 2 to 4. They are commonly stratified silty clay loam, silt loam, silt, very fine sand, or fine sand.

Charlevoix Series

The Charlevoix series consists of deep, somewhat poorly drained, moderately permeable or moderately rapidly permeable soils on ground moraines. These soils formed in loamy till. Slope ranges from 0 to 6 percent.

Typical pedon of Charlevoix fine sandy loam, 0 to 3 percent slopes, approximately 2,390 feet south and 2,510 feet east of the northwest corner of sec. 9, T. 30 N., R. 21 E.

A—0 to 4 inches; black (10YR 2/1) fine sandy loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; many fibrous roots; strongly acid; abrupt wavy boundary.

E—4 to 6 inches; light brownish gray (10YR 6/2) fine sandy loam, gray (10YR 6/1) dry; common fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; many fibrous roots; strongly acid; abrupt wavy boundary.

Bs—6 to 14 inches; brown (7.5YR 5/4) fine sandy loam; common fine prominent yellowish brown (10YR 5/6) mottles; weak fine and very fine subangular blocky structure; very friable; few fine roots; medium acid; abrupt wavy boundary.

B/E—14 to 20 inches; about 80 percent brown (7.5YR 5/4) fine sandy loam (Bt); few fine prominent grayish brown (10YR 5/2) and common medium prominent yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; very friable; about 20 percent interfingering of brown (7.5YR 5/2) fine sandy loam (E); few fine roots; slightly acid; gradual irregular boundary.

Bt1—20 to 24 inches; brown (7.5YR 4/4) loam; common medium prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; friable; few fine roots; few faint patchy dark brown (7.5YR 3/4) clay films on faces of peds; neutral; abrupt wavy boundary.

Bt2—24 to 27 inches; reddish brown (5YR 4/4) sandy loam; common medium prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; very friable; patchy clay films on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

C—27 to 60 inches; reddish brown (5YR 5/3) sandy loam; moderate medium prominent strong brown (7.5YR 5/6) mottles; massive; friable; slightly effervescent; about 5 percent gravel; mildly alkaline.

The thickness of the solum ranges from 16 to 36 inches. The content of gravel ranges from 0 to 10 percent in the upper part of the solum and from 5 to 15 percent in the lower part of the solum and in the substratum.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has value of 5 or 6 and chroma of 2 or 3. It is loam, fine sandy loam, or sandy loam. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 or 4. It is fine sandy loam or sandy loam. The Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is sandy clay loam, loam, sandy loam, or fine sandy loam. The C horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. It is fine sandy loam, sandy loam, or gravelly sandy loam.

Croswell Series

The Croswell series consists of deep, moderately well drained, rapidly permeable soils on outwash plains and in glacial lake basins. These soils formed in sandy outwash deposits. Slope ranges from 1 to 6 percent.

Typical pedon of Croswell loamy sand, 1 to 6 percent slopes, approximately 1,920 feet south and 600 feet west of the northeast corner of sec. 15, T. 34 N., R. 19 E.

Oe—1 inch to 0; black (10YR 2/1) mat of needles.

A—0 to 1 inch; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; many fine roots; very strongly acid; abrupt smooth boundary.

E—1 to 3 inches; brown (7.5YR 5/2) loamy sand, light brownish gray (10YR 6/2) dry; weak thick platy structure; very friable; many fine roots; very strongly acid; clear wavy boundary.

Bs1—3 to 8 inches; dark reddish brown (5YR 3/4) loamy sand; weak medium subangular blocky structure; very friable; many fine roots; few small iron concretions; very strongly acid; clear wavy boundary.

Bs2—8 to 19 inches; reddish brown (5YR 4/4) sand; weak medium subangular blocky structure; very friable; strongly acid; gradual wavy boundary.

BC—19 to 30 inches; yellowish red (5YR 4/6) sand; many medium distinct reddish brown (5YR 5/3) and yellowish red (5YR 5/8) mottles; weak medium subangular blocky structure; very friable; medium acid; gradual wavy boundary.

C1—30 to 40 inches; reddish brown (5YR 5/4) sand; many medium distinct reddish gray (5YR 5/2), reddish brown (5YR 5/3), and yellowish red (5YR 5/8) mottles; single grain; loose; medium acid; clear wavy boundary.

C2—40 to 60 inches; brown (7.5YR 5/4) sand; many medium prominent reddish gray (5YR 5/2) and yellowish red (5YR 5/6 and 5/8) mottles; single grain; loose; medium acid.

The thickness of the solum ranges from 24 to 36 inches. The depth to mottling ranges from 19 to 40 inches. The content of gravel ranges from 0 to 10 percent throughout the profile.

The A horizon has value of 2 or 3. The E horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 1 or 2. It is sand or loamy sand. The Bs1 horizon has hue of 7.5YR or 5YR, value of 3 to 5, and chroma of 3 to 6. The Bs2 horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. It is sand or loamy sand. The C horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6.

Cunard Series

The Cunard series consists of moderately deep, well drained soils on ground moraines. These soils are moderately permeable. They formed in loamy till underlain by dolomite (fig. 20). Slope ranges from 1 to 6 percent.

Typical pedon of Cunard loam, 1 to 6 percent slopes, approximately 400 feet south and 40 feet west of the northeast corner of sec. 30, T. 31 N., R. 22 E.

Ap—0 to 5 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; very friable; many very fine roots; about 10 percent dolomite gravel; neutral; abrupt wavy boundary.

E/B—5 to 11 inches; about 70 percent brown (7.5YR 5/4) fine sandy loam (E); moderate fine and medium subangular blocky structure; very friable; surrounds dark brown (7.5YR 4/4) fine sandy loam (Bt); few fine roots; about 10 percent dolomite gravel; neutral; abrupt wavy boundary.

Bt—11 to 22 inches; reddish brown (5YR 4/4) loam; moderate medium subangular blocky structure; friable; few fine roots; common faint thin patchy reddish brown (5YR 5/4) clay films on faces of peds; about 10 percent dolomite gravel; neutral; clear wavy boundary.

BC—22 to 24 inches; brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; about 10 percent dolomite gravel; mildly alkaline; abrupt wavy boundary.

C—24 to 29 inches; brown (7.5YR 5/4) gravelly sandy

loam; massive; friable; slightly effervescent; about 15 percent dolomite gravel; mildly alkaline; abrupt smooth boundary.

2R—29 inches; dolomite.

The thickness of the solum ranges from 18 to 36 inches. The depth to dolomite ranges from 20 to 40 inches. The content of gravel ranges from 2 to 15 percent in the solum and 5 to 25 percent in the substratum. The content of cobbles ranges from 0 to 10 percent throughout the profile.

The Ap horizon has hue of 10YR or 7.5YR and value and chroma of 2 or 3. Some pedons have an A horizon. This horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The E part of the E/B horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. It is loam, fine sandy loam, or sandy loam. The Bt horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 4 to 6. It is loam, fine sandy loam, sandy loam, or the gravelly analogs of these textures. The BC horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is fine sandy loam or sandy loam. The C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 or 4. It is sandy loam, fine sandy loam, loam, or the gravelly analogs of these textures. Some pedons do not have a C horizon.

Dawson Series

The Dawson series consists of deep, very poorly drained soils in glacial lake basins and on moraines and outwash plains. These soils formed in herbaceous organic material underlain by sandy deposits. Permeability is moderately slow to moderately rapid in the organic material and rapid in the underlying sandy deposits. Slope is 0 to 1 percent.

Typical pedon of Dawson peat, in an area of Loxley and Dawson peats, 0 to 1 percent slopes; approximately 1,720 feet south and 1,120 feet east of the northwest corner of sec. 36, T. 37 N., R. 17 E.

Oi—0 to 8 inches; very pale brown (10YR 7/3), broken face and rubbed, fibric material; about 100 percent fiber, 100 percent rubbed; massive; herbaceous fibers of undecomposed sphagnum moss; extremely acid (pH 4.0 by Truog method); abrupt smooth boundary.

Oa1—8 to 22 inches; very dark brown (10YR 2/2), broken face and rubbed, sapric material; about 30 percent fiber, less than 5 percent rubbed; weak thin platy structure; herbaceous fibers; few fine roots; extremely acid (pH 4.0 by Truog method); abrupt smooth boundary.

Oa2—22 to 27 inches; black (10YR 2/1), broken face, sapric material, very dark brown (10YR 2/2) rubbed; about 30 percent fiber, about 5 percent rubbed; massive; herbaceous fibers; few fine roots; extremely acid (pH 4.2 by Truog method); abrupt smooth boundary.

Oa3—27 to 31 inches; black (10YR 2/1), broken face and rubbed, sapric material; about 10 percent fiber, less than 2 percent rubbed; massive; herbaceous fibers; about 10 percent mineral content; extremely acid (pH 4.2 by Truog method); abrupt smooth boundary.

Oa4—31 to 36 inches; black (10YR 2/1), broken face and rubbed, sapric material; about 5 percent fiber, less than 2 percent rubbed; massive; herbaceous fibers; about 15 percent mineral content; extremely acid (pH 4.2 by Truog method); abrupt smooth boundary.

C—36 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; very strongly acid.

The thickness of the organic material and the depth to the sandy C horizon range from 16 to 51 inches. Typically, undecomposed sphagnum moss is in the upper 8 to 14 inches. The subsurface and bottom tiers of some pedons have as much as 10 inches of hemic material or 5 inches of fibric material. The C horizon is sand, but in some pedons it is fine sand or the gravelly analogs of these textures.

Deford Series

The Deford series consists of deep, poorly drained and very poorly drained, rapidly permeable soils on outwash plains and moraines and in glacial lake basins. These soils formed in deposits of sandy material, which is dominantly fine sand in size. Slope ranges from 0 to 2 percent.

Typical pedon of Deford mucky fine sand, 0 to 2 percent slopes, approximately 1,980 feet south and 900 feet east of the northwest corner of sec. 17, T. 29 N., R. 23 E.

Oe—1 inch to 0; black (10YR 2/1) leaf litter.

A—0 to 2 inches; black (10YR 2/1) mucky fine sand, gray (10YR 6/1) dry; weak fine subangular blocky structure; very friable; many fine roots; medium acid; abrupt smooth boundary.

Cg1—2 to 6 inches; light brownish gray (10YR 6/2) fine sand; few fine prominent reddish yellow (7.5YR 6/6) mottles; single grain; loose; many fine roots; medium acid; abrupt smooth boundary.

Cg2—6 to 14 inches; light brownish gray (10YR 6/2)

fine sand; few fine prominent strong brown (7.5YR 5/6) mottles; single grain; loose; slightly acid; abrupt smooth boundary.

C1—14 to 34 inches; yellowish brown (10YR 5/4) fine sand; few fine distinct grayish brown (10YR 5/2) and common medium distinct strong brown (7.5YR 5/6) mottles; single grain; loose; matrix color is of uncoated sand grains; neutral; abrupt smooth boundary.

C2—34 to 60 inches; brown (10YR 5/3) fine sand; single grain; loose; matrix color is of uncoated sand grains; neutral.

The Cg and C horizons have hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. They are fine sand, very fine sand, or loamy fine sand. In some pedons they have thin strata of sand or loamy sand.

Emmert Series

The Emmert series consists of deep, excessively drained, very rapidly permeable soils on kames, eskers, and moraines. These soils formed in thin deposits of loamy material and in the underlying gravelly or very gravelly sand outwash. Slope ranges from 6 to 35 percent.

Typical pedon of Emmert gravelly sandy loam, in an area of Emmert-Pence-Sarona complex, 15 to 35 percent slopes; approximately 700 feet north and 1,500 feet west of the southeast corner of sec. 14, T. 36 N., R. 17 E.

A—0 to 2 inches; very dark brown (10YR 2/2) gravelly sandy loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; very friable; many roots; about 15 percent gravel; medium acid; abrupt smooth boundary.

Bw—2 to 8 inches; brown (7.5YR 4/4) gravelly loamy sand; weak medium subangular blocky structure; very friable; many roots; about 15 percent gravel; medium acid; clear wavy boundary.

BC—8 to 23 inches; brown (7.5YR 5/4) very gravelly sand; single grain; loose; about 40 percent gravel; slightly acid; diffuse irregular boundary.

C—23 to 60 inches; strong brown (7.5YR 5/6) very gravelly sand; single grain; loose; some strata of sand; about 50 percent gravel and 10 percent cobbles; medium acid.

The thickness of the solum ranges from 15 to 28 inches. The content of gravel ranges from 10 to 25 percent in the upper part of the profile and from 35 to 60 percent in the lower part. The content of cobbles ranges from 0 to 7 percent in the upper part of the profile and from 0 to 20 percent in the lower part.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bw horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. It is sandy loam, loamy sand, sand, or the gravelly analogs of these textures. The BC horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is gravelly or very gravelly sand or gravelly or very gravelly loamy sand. The C horizon has colors similar to those of the BC horizon.

Emmet Series

The Emmet series consists of deep, well drained soils on moraines and drumlins (fig. 21). These soils formed in predominantly loamy till. Permeability is moderate in the upper part of the profile and moderate or moderately rapid in the lower part. Slope ranges from 1 to 30 percent.

Typical pedon of Emmet fine sandy loam, 1 to 6 percent slopes, approximately 25 feet south and 1,120 feet west of the northeast corner of sec. 9, T. 32 N., R. 20 E.

A—0 to 3 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; very friable; many fine roots; slightly acid; abrupt wavy boundary.

E—3 to 4 inches; pinkish gray (7.5YR 6/2) fine sandy loam, pale brown (10YR 6/3) dry; weak thin platy structure; very friable; many fine roots; medium acid; abrupt wavy boundary.

Bw—4 to 10 inches; brown (7.5YR 4/4) fine sandy loam; weak fine subangular blocky structure; very friable; common fine and medium roots; medium acid; clear irregular boundary.

E'—10 to 13 inches; light brownish gray (10YR 6/2) fine sandy loam; weak thin platy structure; very friable; few fine roots; about 2 percent gravel; medium acid; abrupt wavy boundary.

E/B—13 to 18 inches; about 60 percent light brownish gray (10YR 6/2) fine sandy loam (E); moderate medium subangular blocky structure; very friable; about 40 percent tongues of E material extending into or completely surrounding isolated remnants of dark reddish brown (5YR 3/4) fine sandy loam (Bt); moderate medium subangular blocky structure; firm; few fine roots; about 3 percent gravel; slightly acid; clear irregular boundary.

Bt—18 to 26 inches; dark reddish brown (5YR 3/4) fine sandy loam; moderate medium subangular blocky structure; friable; few fine roots; few distinct continuous reddish brown (5YR 4/4) clay films on

faces of peds; about 6 percent gravel; mildly alkaline; abrupt wavy boundary.

BC—26 to 33 inches; yellowish red (5YR 4/6) fine sandy loam; weak medium subangular blocky structure; friable; about 9 percent gravel; mildly alkaline; clear wavy boundary.

C—33 to 60 inches; reddish brown (5YR 4/3) fine sandy loam; massive; friable; slightly effervescent; about 9 percent gravel; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 24 to 48 inches. The content of gravel ranges from 0 to 15 percent in the solum and from 5 to 25 percent in the substratum. The content of cobbles mostly ranges from 0 to 5 percent throughout the profile. In the cobbly phases, however, the content of cobbles is 12 to 20 percent in the surface layer and 3 to 10 percent in the subsoil and substratum.

The A horizon has chroma of 1 or 2. It is fine sandy loam or cobbly fine sandy loam. The E horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 1 to 3. It is fine sandy loam, sandy loam, or loamy sand. The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. The E' horizon has characteristics of a fragipan in some pedons. It has value of 5 or 6 and chroma of 2 or 3. It is fine sandy loam or sandy loam. The E/B horizon has characteristics of the E' and Bt horizon. The Bt horizon has hue of 5YR or 7.5YR and value and chroma of 3 or 4. It is sandy loam, fine sandy loam, loam, or sandy clay loam. Some pedons do not have a BC horizon. The C horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. It is fine sandy loam, sandy loam, loam, or the gravelly analogs of these textures. In some pedons it has strata of loamy sand, sand, or gravel.

Ensley Series

The Ensley series consists of deep, poorly drained and very poorly drained soils on ground moraines. These soils formed in loamy till. Permeability is moderate in the subsoil and moderate or moderately rapid in the substratum. Slope ranges from 0 to 2 percent.

Typical pedon of Ensley loam, 0 to 2 percent slopes, approximately 2,245 feet north and 1,780 feet east of the southwest corner of sec. 36, T. 30 N., R. 22 E.

A—0 to 5 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; common fine fibrous roots; neutral; abrupt smooth boundary.

Bg1—5 to 9 inches; dark grayish brown (10YR 4/2) loam; many coarse prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; many fine fibrous roots; neutral; abrupt smooth boundary.

Bg2—9 to 18 inches; grayish brown (10YR 5/2) fine sandy loam; common medium prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; mildly alkaline; abrupt smooth boundary.

BC—18 to 25 inches; reddish brown (5YR 4/3) fine sandy loam; common fine prominent strong brown (7.5YR 5/8) and common medium prominent gray (10YR 5/1) mottles; weak medium and coarse subangular blocky structure; very friable; about 4 percent dolomite gravel; mildly alkaline; clear wavy boundary.

C—25 to 60 inches; reddish brown (5YR 5/3) fine sandy loam; common medium prominent strong brown (7.5YR 5/8) and few fine prominent grayish brown (10YR 5/2) mottles; massive; very friable; slightly effervescent; about 10 percent dolomite gravel; mildly alkaline.

The thickness of the solum ranges from 14 to 30 inches. The content of gravel ranges from 0 to 15 percent in the solum and from 5 to 25 percent in the substratum. The content of cobbles ranges from 0 to 3 percent in the surface layer.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bg1 horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6; and chroma of 1 or 2. It is sandy loam, fine sandy loam, loam, or sandy clay loam. The Bg2 horizon has hue of 10YR, 7.5YR, or 5YR; value of 4 to 6; and chroma of 2 to 4. It is fine sandy loam, loam, or sandy clay loam. The BC horizon has hue of 5YR or 7.5YR and value and chroma of 4 to 6. It is loam, fine sandy loam, or sandy loam. The C horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is fine sandy loam, loam, sandy loam, or the gravelly analogs of these textures.

Fence Series

The Fence series consists of deep, well drained, moderately slowly permeable soils in glacial lake basins and on outwash plains. These soils formed in silty and loamy deposits underlain by silt or stratified silt and sandy lacustrine deposits. Slope ranges from 2 to 15 percent.

Typical pedon of Fence silt loam, 2 to 6 percent slopes, approximately 290 feet south and 1,000 feet east of the northwest corner of sec. 2, T. 37 N., R. 18 E.

Oe—1 inch to 0; black (10YR 2/1) partially decomposed leaves, twigs, and needles.
A—0 to 2 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many fine fibrous roots; strongly acid; abrupt wavy boundary.
E—2 to 5 inches; reddish gray (5YR 5/2) silt loam, pinkish gray (5YR 7/2) dry; weak thin platy structure; very friable; many fine fibrous roots; strongly acid; abrupt wavy boundary.
Bs1—5 to 10 inches; reddish brown (5YR 4/4) silt; weak medium subangular blocky structure; friable; many roots; strongly acid; clear wavy boundary.
Bs2—10 to 17 inches; reddish brown (5YR 4/4) silt; moderate medium subangular blocky structure; friable; few fine roots; strongly acid; abrupt wavy boundary.
E'—17 to 19 inches; reddish brown (5YR 5/3) silt; moderate medium subangular blocky structure; friable; strongly acid; gradual irregular boundary.
E/B—19 to 29 inches; about 75 percent reddish brown (5YR 5/3) silt (E); moderate medium subangular blocky structure; friable; about 25 percent tongues of E material extending into or completely surrounding isolated remnants of yellowish red (5YR 4/6) silt loam (Bt); moderate fine and medium subangular blocky structure; friable; strongly acid; abrupt wavy boundary.
Bt—29 to 39 inches; yellowish red (5YR 4/6) silt loam; moderate medium and coarse subangular blocky structure; friable; common faint thin patchy reddish brown (5YR 4/4) clay films on faces of peds; strongly acid; abrupt wavy boundary.
C—39 to 60 inches; reddish brown (5YR 5/3) silt; massive with tendency to part along horizontal cleavage planes; friable; strongly acid.

The thickness of the solum ranges from 30 to 49 inches. Some pedons have mottles of high chroma in the lower part of the C horizon.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The Bs1 and Bs2 horizons have hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. They are silt, silt loam, or very fine sandy loam. The E' horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is silt or silt loam. The E/B horizon has colors and textures similar to those of the E' and Bt horizons. The Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam, silt, or very fine sandy loam. The C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silt or silt stratified with very fine sand.

Forada Series

The Forada series consists of deep, poorly drained and very poorly drained soils on outwash plains and ground moraines. These soils formed in loamy deposits underlain by calcareous sandy and gravelly outwash. Permeability is moderately rapid in the subsoil and rapid in the substratum. Slope is 0 to 1 percent.

Typical pedon of Forada mucky loam, 0 to 1 percent slopes, approximately 130 feet south and 595 feet west of the northeast corner of sec. 14, T. 31 N., R. 21 E.

A—0 to 9 inches; black (10YR 2/1) mucky loam; moderate fine subangular blocky structure; very friable; many fine roots; mildly alkaline; abrupt smooth boundary.
Bg—9 to 17 inches; dark grayish brown (10YR 4/2) loam; common few distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; friable; few fine roots; mildly alkaline; abrupt smooth boundary.
BCg—17 to 26 inches; grayish brown (10YR 5/2) fine sandy loam; moderate medium distinct light yellowish brown (10YR 6/4) mottles; weak medium subangular blocky structure; very friable; mildly alkaline; clear wavy boundary.
C1—26 to 48 inches; yellowish brown (10YR 5/6) sand; many coarse distinct brownish yellow (10YR 6/8) mottles; single grain; loose; slightly effervescent; about 12 percent gravel; moderately alkaline; abrupt smooth boundary.
C2g—48 to 60 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; single grain; loose; slightly effervescent; about 15 percent gravel; moderately alkaline.

The thickness of the solum ranges from 15 to 30 inches. The content of gravel ranges from 0 to 10 percent in the solum and from 12 to 35 percent in the substratum.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is loam, fine sandy loam, or sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is sand, coarse sand, or gravelly coarse sand.

Gaastra Series

The Gaastra series consists of deep, somewhat

poorly drained, moderately slowly permeable soils in glacial lake basins, on ground moraines, and on outwash plains. These soils formed in silty deposits and in the underlying silty and loamy lacustrine deposits. Slope ranges from 0 to 3 percent.

Typical pedon of Gaastra silt loam, 0 to 3 percent slopes, approximately 130 feet south and 1,340 feet west of the northeast corner of sec. 2, T. 37 N., R. 18 E.

A—0 to 3 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; many fine roots; very strongly acid; abrupt smooth boundary.

E—3 to 5 inches; gray (10YR 5/1) silt loam, light gray (10YR 7/1) dry; common fine distinct light yellowish brown (10YR 6/4) mottles; weak thin platy structure; very friable; common fine roots; very strongly acid; abrupt wavy boundary.

Bs—5 to 11 inches; strong brown (7.5YR 5/4) silt loam; common medium distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; common fine roots; slightly acid; abrupt wavy boundary.

E'—11 to 13 inches; pale brown (10YR 6/3) silt loam; common medium distinct grayish brown (10YR 5/2) and common medium prominent strong brown (7.5YR 5/6) mottles; weak thin platy structure; very friable; few fine roots; slightly acid; abrupt wavy boundary.

Bt—13 to 20 inches; reddish brown (5YR 4/3) silt loam; few fine prominent grayish brown (10YR 5/2) and many coarse prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; few faint patchy reddish brown (5YR 4/4) clay films on faces of peds; neutral; clear wavy boundary.

BC—20 to 26 inches; reddish brown (5YR 5/3) silt loam; many medium prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; neutral; gradual wavy boundary.

C1—26 to 34 inches; reddish brown (5YR 5/3) silt loam; few fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; neutral; abrupt smooth boundary.

C2—34 to 60 inches; reddish brown (5YR 5/3) silt loam; common medium faint reddish brown (5YR 5/4) mottles; massive parting to moderate thin and medium plates; friable; neutral.

The thickness of the solum ranges from 26 to 36 inches. The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 1 or 2. The Bs horizon has value and chroma of 4 to 6. The E' horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 or 3. Some pedons have a B/E horizon. This horizon has colors similar to those of the E' and Bt horizons. The Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is silt loam or very fine sandy loam. The C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is silt loam, silt, or very fine sandy loam. In some pedons it has thin strata of very fine sand.

Goodman Series

The Goodman series consists of deep, well drained, moderately permeable soils on ground moraines. These soils formed in silty eolian deposits and in the underlying loamy or sandy till. Slope ranges from 2 to 15 percent.

Typical pedon of Goodman silt loam, 2 to 6 percent slopes, approximately 2,360 feet north and 2,070 feet east of the southwest corner of sec. 2, T. 37 N., R. 17 E.

Oe—1 inch to 0; undecomposed leaf litter and twigs.

A—0 to 4 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; many fine fibrous roots; extremely acid; abrupt smooth boundary.

E—4 to 6 inches; brown (7.5YR 4/2) silt loam; weak thin platy structure; very friable; many fine fibrous roots; extremely acid; abrupt wavy boundary.

Bs1—6 to 11 inches; dark reddish gray (5YR 4/2) silt loam; moderate fine subangular blocky structure; friable; many fine fibrous roots; extremely acid; clear wavy boundary.

Bs2—11 to 25 inches; brown (7.5YR 4/4) silt loam; moderate fine subangular blocky structure; friable; many fine and medium roots; very strongly acid; clear wavy boundary.

E/B—25 to 31 inches; about 70 percent pinkish gray (7.5YR 6/2) silt loam (E); moderate thin platy structure; friable; about 30 percent tongues of E material extending into or completely surrounding isolated remnants of brown (7.5YR 4/4) silt loam (Bt); moderate fine and medium subangular blocky structure; friable; strongly acid; gradual wavy boundary.

B/E—31 to 35 inches; about 65 percent brown (7.5YR 4/4) silt loam (Bt); moderate medium subangular

blocky structure; friable; patchy reddish brown (5YR 4/4) clay films on faces of peds; about 35 percent tongues of pinkish gray (7.5YR 6/2) silt loam (E); moderate medium subangular blocky structure; very weakly cemented; very strongly acid; abrupt wavy boundary.

2BC—35 to 37 inches; reddish brown (5YR 4/4) fine sandy loam; weak fine subangular blocky structure; very friable; about 5 percent gravel; very strongly acid; abrupt wavy boundary.

2C—37 to 60 inches; reddish brown (5YR 5/4) sandy loam; massive; very friable; about 5 percent gravel; strongly acid.

The thickness of the silty deposits over the glacial till ranges from 15 to 35 inches. The thickness of the solum ranges from 33 to 49 inches. The content of gravel ranges from 0 to 7 percent in the silty deposits and from 0 to 25 percent in the underlying till. The content of cobbles ranges from 0 to 10 percent throughout the profile.

The A horizon has value of 2 to 4 and chroma of 1 or 2. The E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 or 3. The Bs1 and Bs2 horizons have hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. The Bt part of the E/B and B/E horizons has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The BC horizon is fine sandy loam, sandy loam, or loam. The 2C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is sandy loam, gravelly sandy loam, fine sandy loam, or loamy sand.

Hibbing Series

The Hibbing series consists of deep, well drained, slowly permeable soils in glacial lake basins. These soils formed in thin deposits of silty material and in the underlying clayey lacustrine deposits. Slope ranges from 1 to 6 percent.

Typical pedon of Hibbing silt loam, 1 to 6 percent slopes, approximately 2,340 feet south and 80 feet east of the northwest corner of sec. 25, T. 37 N., R. 18 E.

A—0 to 3 inches; dark brown (7.5YR 3/2) silt loam, pinkish gray (7.5YR 6/2) dry; moderate fine subangular blocky structure; very friable; many fine roots; medium acid; abrupt smooth boundary.

E—3 to 5 inches; reddish brown (5YR 5/3) silt loam, pinkish gray (5YR 6/2) dry; weak medium platy structure; very friable; many fine roots; medium acid; abrupt smooth boundary.

E/B—5 to 13 inches; about 60 percent reddish gray (5YR 5/2) silty clay loam (E); weak medium platy structure; firm; about 40 percent interfingers that penetrate upward extensions of reddish brown (5YR 4/4) silty clay (Bt); strong medium angular blocky structure; firm; many fine roots; much mixing by earthworms; slightly acid; clear wavy boundary.

Bt1—13 to 21 inches; reddish brown (2.5YR 4/4) silty clay; strong medium angular blocky structure; firm; few fine roots; many faint reddish brown (2.5YR 5/4) thick continuous clay films on faces of peds; neutral; clear wavy boundary.

Bt2—21 to 26 inches; reddish brown (2.5YR 4/4) silty clay; strong fine angular blocky structure; firm; few fine roots; many faint reddish brown (2.5YR 4/4) thin continuous clay films on faces of peds; neutral; clear wavy boundary.

Bt3—26 to 30 inches; reddish brown (5YR 4/4) silty clay; moderate fine subangular blocky structure; firm; few fine roots; few faint thin discontinuous reddish brown (5YR 4/4) clay films on faces of peds; mildly alkaline; abrupt wavy boundary.

C—30 to 60 inches; reddish brown (5YR 4/4) silty clay; massive; firm; strongly effervescent; few segregated lime spots and streaks; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 24 to 36 inches. The A horizon has hue of 10YR or 7.5YR, value of 2 to 4, and chroma of 1 or 2. The E horizon has hue of 5YR, 7.5YR, or 10YR; value of 4 to 6; and chroma of 2 or 3. The Bt horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 2 to 4. It is silty clay or clay. The C horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 3 or 4. It is silty clay or clay.

Iosco Series

The Iosco series consists of deep, somewhat poorly drained soils on ground moraines and outwash plains. These soils formed in sandy deposits and in the underlying calcareous loamy till. Permeability is rapid in the sandy upper part of the subsoil and moderate in the loamy lower part of the subsoil and in the substratum. Slope ranges from 0 to 3 percent.

Typical pedon of Iosco loamy fine sand, 0 to 3 percent slopes, approximately 1,300 feet south and 780 feet west of the northeast corner of sec. 6, T. 30 N., R. 23 E.

Ap—0 to 9 inches; very dark brown (10YR 2/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; common fine roots; medium acid; abrupt smooth boundary.

Bs1—9 to 13 inches; brown (7.5YR 5/4) fine sand;

common medium prominent yellowish red (5YR 5/6) mottles; weak medium subangular blocky structure; very friable; few fine roots; neutral; clear wavy boundary.

Bs2—13 to 24 inches; brown (7.5YR 4/4) fine sand; common medium prominent yellowish red (5YR 5/8) mottles; weak medium and coarse subangular blocky structure; very friable; few fine roots; mildly alkaline; abrupt wavy boundary.

2Bt—24 to 28 inches; reddish brown (5YR 4/3) loam; common medium prominent strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; friable; few patchy yellowish red (5YR 4/6) clay films on faces of peds; common medium prominent light brown (7.5YR 6/4) lime accumulations; strongly effervescent; about 6 percent gravel; moderately alkaline; clear wavy boundary.

2C—28 to 60 inches; brown (7.5YR 5/4) fine sandy loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; common medium faint light brown (7.5YR 6/4) lime accumulations; violently effervescent; about 8 percent gravel; moderately alkaline.

The thickness of the sandy mantle and the depth to glacial till range from 20 to 40 inches. The content of gravel ranges from 0 to 15 percent in the sandy mantle and from 0 to 25 percent in the loamy subsoil and substratum. The content of cobbles ranges from 0 to 3 percent in the sandy mantle and from 0 to 7 percent in the loamy subsoil and substratum.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. Some pedons have an E horizon. This horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2. It is loamy fine sand, sand, or fine sand. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is loamy sand, fine sand, or sand. The 2Bt horizon has hue of 5YR or 7.5YR and value and chroma of 3 or 4. It is loam, fine sandy loam, sandy clay loam, or the gravelly analogs of these textures. The 2C horizon has hue of 2.5YR, 5YR, or 7.5YR; value of 4 or 5; and chroma of 3 to 5. It is sandy loam, fine sandy loam, loam, or the gravelly analogs of these textures.

Ishpeming Series

The Ishpeming series consists of moderately deep, somewhat excessively drained soils on outwash plains and moraines. These soils formed in sandy outwash deposits underlain by igneous or metamorphic bedrock. Permeability is rapid. Slope ranges from 4 to 15 percent.

Typical pedon of Ishpeming loamy fine sand, in an area of Ishpeming-Rock outcrop complex, 4 to 15 percent slopes; approximately 1,800 feet north and 50 feet west of the southeast corner of sec. 27, T. 37 N., R. 20 E.

A—0 to 3 inches; very dark gray (10YR 3/1) loamy fine sand, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; very friable; many fine fibrous roots; slightly acid; abrupt wavy boundary.

E—3 to 6 inches; pinkish gray (5YR 6/2) loamy fine sand, pinkish gray (7.5YR 6/2) dry; weak medium subangular blocky structure; very friable; many very fine fibrous roots; slightly acid; abrupt wavy boundary.

Bs1—6 to 9 inches; dark reddish brown (5YR 3/4) loamy fine sand; weak fine and medium subangular blocky structure; very friable; few fine roots; slightly acid; clear wavy boundary.

Bs2—9 to 17 inches; reddish brown (5YR 4/4) loamy fine sand; weak fine and medium subangular blocky structure; very friable; few fine roots; slightly acid; clear wavy boundary.

BC—17 to 24 inches; reddish brown (5YR 4/4) fine sand; weak medium subangular blocky structure; very friable; few fine roots; slightly acid; gradual wavy boundary.

C—24 to 36 inches; brown (7.5YR 5/4) fine sand; single grain; loose; few fine roots; slightly acid; abrupt wavy boundary.

2R—36 inches; granite.

The thickness of the solum and the depth to granite range from 20 to 40 inches. The content of gravel and the content of cobbles range from 0 to 10 percent throughout the profile.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 5YR or 7.5YR, value of 6 or 7, and chroma of 2 or 3. It is loamy fine sand, fine sand, or sand. The Bs1 horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 4 to 6. The Bs2 horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The BC horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The B horizon is loamy fine sand, loamy sand, or fine sand. The C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 6. It is fine sand, loamy fine sand, or loamy sand. Some pedons do not have a C horizon. The underlying bedrock is igneous or metamorphic.

Figure 19.—Profile of an Au Gres soil. Organic matter and iron and aluminum compounds have been leached from the light colored subsurface layer and deposited in the upper part of the subsoil. Depth is marked in feet.

Figure 20.—Profile of a Cunard soil. Dolomite bedrock is at a depth of about 27 inches. The plow layer is underlain by a subsoil layer of clay accumulation, which extends to the bedrock. Plowing has obliterated the subsurface layer in this profile. Depth is marked in feet.

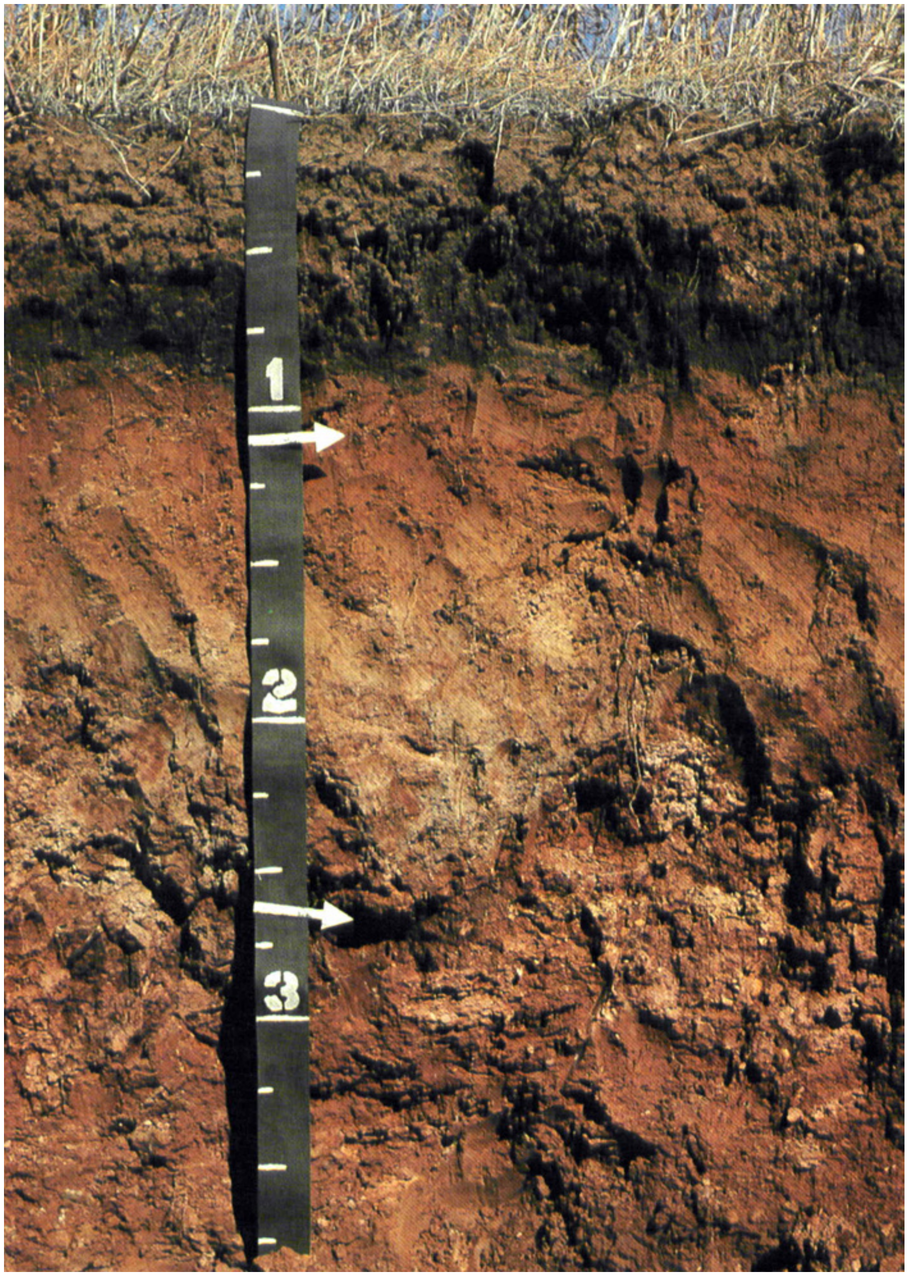

Figure 21.—Profile of an Emmet soil. The top arrow indicates the upper part of the subsoil. Below the bottom arrow is a subsoil layer of clay accumulation. Plowing has obliterated the subsurface layer in this profile. Depth is marked in feet.

Figure 22.—Profile of a Mancelona soil. A dark reddish brown subsoil layer of clay accumulation is directly above a very gravelly sand substratum. Depth is marked in feet.

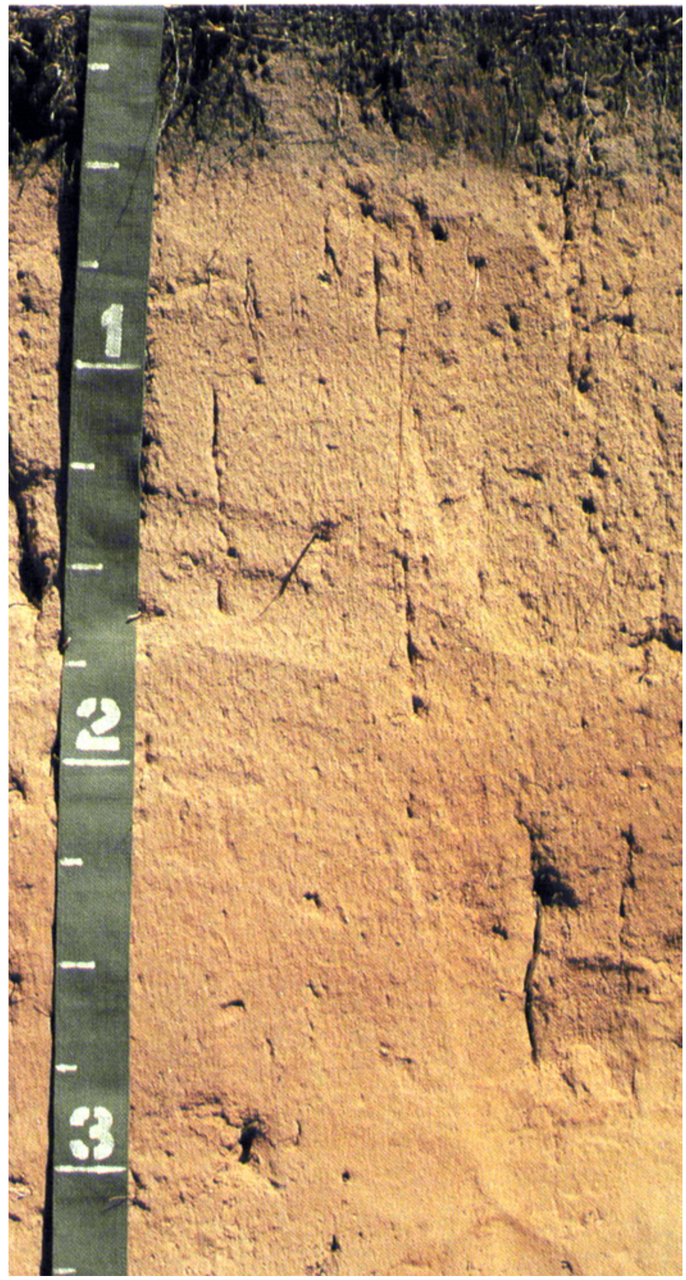

Figure 23.—Profile of a sandy Menahga soil. A thin surface layer of organic matter accumulation is underlain by a subsoil layer having weak structure. Depth is marked in feet.

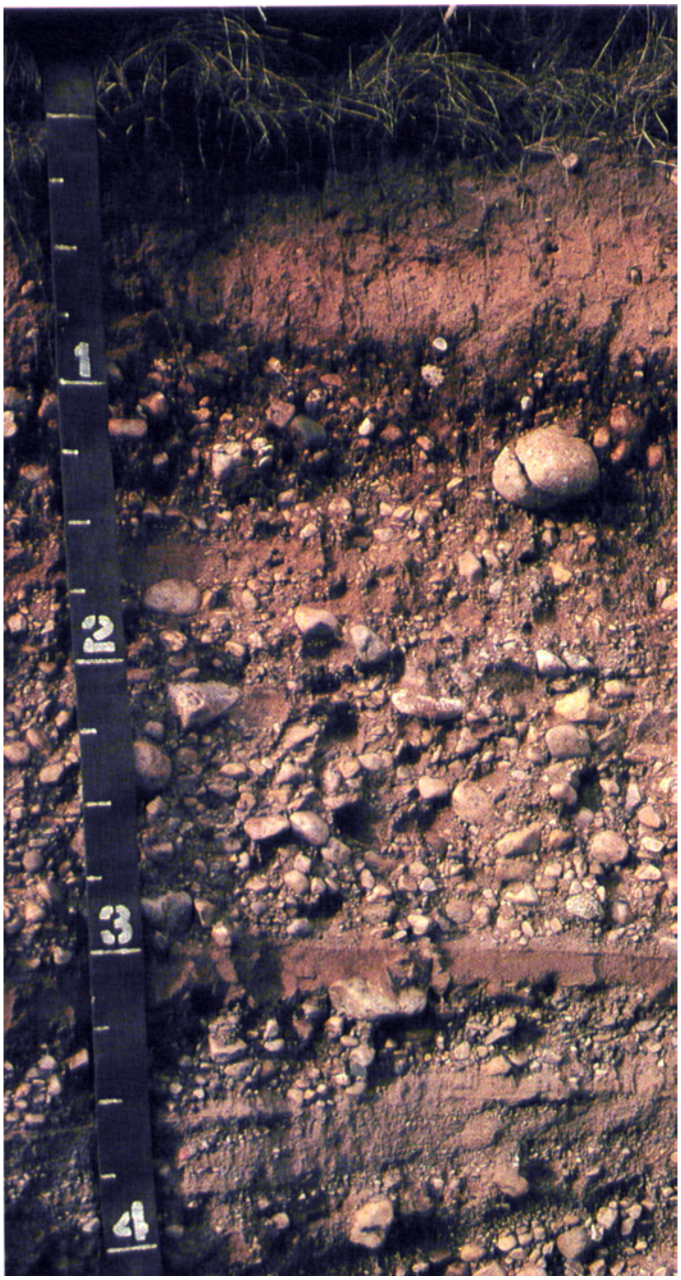

Figure 24.—Profile of a Nadeau soil. A thin surface layer of organic matter accumulation is underlain by a thin subsoil of clay accumulation. The very gravelly sand substratum is below a depth of about 18 inches. Depth is marked in feet.

Figure 25.—Profile of a Shawano soil. The surface layer has been thickened and darkened by good farming practices. The subsoil has indistinct horizons. Depth is marked in feet.

Karlin Series

The Karlin series consists of deep, somewhat excessively drained soils on moraines and outwash plains. These soils formed in sandy deposits. Permeability is moderately rapid in the subsoil and rapid in the substratum. Slope ranges from 2 to 15 percent.

Typical pedon of Karlin loamy fine sand, 2 to 6 percent slopes, approximately 2,000 feet north and 2,540 feet east of the southwest corner of sec. 27, T. 37 N., R. 18 E.

A—0 to 2 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many fine roots; very strongly acid; clear wavy boundary.

E—2 to 3 inches; brown (7.5YR 5/2) loamy fine sand, pinkish gray (7.5YR 6/2) dry; weak fine subangular blocky structure; friable; many fine roots; very strongly acid; clear smooth boundary.

Bs1—3 to 17 inches; brown (7.5YR 4/4) loamy fine sand; weak medium subangular blocky structure; friable; few medium and common fine roots; strongly acid; clear wavy boundary.

Bs2—17 to 30 inches; reddish brown (5YR 4/4) loamy fine sand; weak medium subangular blocky structure; friable; few medium roots; medium acid; clear wavy boundary.

C—30 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; slightly acid.

The thickness of the solum ranges from 16 to 38 inches. The content of gravel ranges from 0 to 15 percent throughout the profile.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 1 or 2. The Bs horizon has hue of 5YR, 7.5YR, or 10YR; value of 3 to 5; and chroma of 4 to 6. The Bs1 horizon is loamy fine sand, loamy sand, or sandy loam. The Bs2 horizon is loamy fine sand, fine sand, or sand. Some pedons have a BC horizon. This horizon has hue of 5YR, 7.5YR, or 10YR; value of 5 or 6; and chroma of 4 to 6. The C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 to 6.

Keweenaw Series

The Keweenaw series consists of deep, well drained soils on ground moraines and water-worked end moraines. These soils formed in sandy and loamy glacial drift. Permeability is moderate or moderately rapid in the upper part of the profile and moderately rapid in the substratum. Slope ranges from 1 to 25 percent.

Typical pedon of Keweenaw loamy sand, 1 to 6 percent slopes, approximately 1,500 feet south and 2,200 feet east of the northwest corner of sec. 31, T. 36 N., R. 20 E.

Oa—3 inches to 0; black (10YR 2/1) decomposed leaf litter; very strongly acid; abrupt smooth boundary.

A—0 to 4 inches; very dark gray (10YR 3/1) loamy sand, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; very friable; many fine fibrous vertical roots; very strongly acid; abrupt wavy boundary.

E—4 to 7 inches; grayish brown (10YR 5/2) loamy sand, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; many fine fibrous roots; medium acid; abrupt wavy boundary.

Bs1—7 to 13 inches; dark brown (7.5YR 4/4) loamy sand; moderate fine and medium subangular blocky structure; friable; common medium roots; slightly acid; clear wavy boundary.

Bs2—13 to 24 inches; strong brown (7.5YR 5/6) loamy sand; weak fine subangular blocky structure; very friable; few fine roots; slightly acid; abrupt wavy boundary.

B/E—24 to 36 inches; about 85 percent reddish brown (5YR 5/4) sandy loam (Bt); weak fine and medium subangular blocky structure; friable; about 15 percent coatings of brown (7.5YR 5/4) loamy sand (E) on faces of peds; discontinuous reddish brown (5YR 4/4) clay films on faces of peds; weak cementation; about 5 percent gravel; slightly acid; clear wavy boundary.

C—36 to 60 inches; yellowish red (5YR 5/6) loamy sand; weak fine subangular blocky structure; very friable; about 5 percent gravel; medium acid.

The thickness of the solum ranges from 29 to 45 inches. The content of gravel ranges from 0 to 20 percent in the subsoil and substratum. The content of cobbles ranges from 0 to 15 percent in the subsoil and substratum.

The A horizon has hue of 10YR or 7.5YR and value of 2 or 3, or it is neutral in hue and has value of 2 or 3. The E horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. The Bs1 and Bs2 horizons have hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. They are loamy sand, sand, or the gravelly analogs of these textures. The Bt part of the B/E horizon has value of 3 to 5 and chroma of 4 to 6. The E part of the B/E horizon has value of 4 or 5. The B/E

horizon is sandy loam, fine sandy loam, loamy sand, or the gravelly analogs of these textures. The C horizon has hue of 5YR, 7.5YR, or 10YR; value of 4 or 5; and chroma of 4 to 6. It is loamy sand or gravelly loamy sand. It has pockets or strata of sand and sandy loam in some pedons.

Loxley Series

The Loxley series consists of deep, very poorly drained soils in glacial lake basins and on moraines and outwash plains. These soils formed in herbaceous organic material. Permeability is moderately slow to moderately rapid. Slope is 0 to 1 percent.

Typical pedon of Loxley peat, in an area of Loxley and Dawson peats, 0 to 1 percent slopes; approximately 970 feet south and 440 feet east of the northwest corner of sec. 13, T. 31 N., R. 21 E.

Oi1—0 to 11 inches; very pale brown (10YR 7/4), broken face, fibric material, very pale brown (10YR 7/3) rubbed; about 95 percent fiber, 85 percent rubbed; massive; herbaceous fibers of undecomposed sphagnum moss; common roots; extremely acid (pH 3.5 by Truog method); abrupt smooth boundary.

Oi2—11 to 15 inches; brown (7.5YR 5/4), broken face and rubbed, fibric material; about 90 percent fiber, 80 percent rubbed; massive; herbaceous fibers of partially decomposed sphagnum moss; common roots; extremely acid (pH 3.5 by Truog method); abrupt smooth boundary.

Oa1—15 to 18 inches; dark reddish brown (5YR 2/2), broken face and rubbed, sapric material; about 30 percent fiber, 10 percent rubbed; weak thick platy structure; herbaceous fibers and 15 to 20 percent wood fragments; few roots; extremely acid (pH 3.8 by Truog method); clear smooth boundary.

Oa2—18 to 21 inches; black (5YR 2/1), broken face and rubbed, sapric material; about 20 percent fiber, 4 percent rubbed; weak medium subangular blocky structure; herbaceous fibers and 10 percent wood fragments; extremely acid (pH 3.8 by Truog method); abrupt smooth boundary.

Oa3—21 to 60 inches; black (5YR 2/1), broken face, sapric material, black (10YR 2/1) rubbed; about 15 percent fiber, 4 percent rubbed; massive; herbaceous fibers and less than 10 percent woody fragments; about 2 percent mineral content; extremely acid (pH 3.8 by Truog method).

The organic material is more than 51 inches thick. It is undecomposed sphagnum moss in the upper 6 to 20 inches. The subsurface and bottom tiers have thin layers of hemic material in some pedons.

Mancelona Series

The Mancelona series consists of deep, somewhat excessively drained soils on outwash plains, stream terraces, and moraines. These soils formed in sandy and loamy deposits underlain by calcareous sand or sand and gravel (fig. 22). Permeability is moderately rapid in the subsoil and very rapid in the substratum. Slope ranges from 0 to 25 percent.

Typical pedon of Mancelona loamy sand, 0 to 6 percent slopes, approximately 10 feet north and 2,400 feet east of the southwest corner of sec. 27, T. 34 N., R. 19 E.

A—0 to 6 inches; black (10YR 2/1) loamy sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many fine and common medium roots; about 3 percent gravel; medium acid; abrupt wavy boundary.

Bs1—6 to 15 inches; dark brown (7.5YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; common fine roots; about 3 percent gravel; slightly acid; abrupt wavy boundary.

Bs2—15 to 21 inches; dark brown (7.5YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; few very fine roots; about 5 percent gravel; neutral; clear wavy boundary.

Bt—21 to 32 inches; dark reddish brown (5YR 3/4) loamy sand; weak medium subangular blocky structure; very friable; few fine roots; few faint thin patchy reddish brown (5YR 4/4) clay films on faces of peds and clay bridging between sand grains; about 12 percent gravel; slightly acid; clear wavy boundary.

BC—32 to 39 inches; dark yellowish brown (10YR 4/4) sand; weak medium subangular blocky structure; very friable; about 10 percent gravel; neutral; clear wavy boundary.

C—39 to 60 inches; pale brown (10YR 6/3) gravelly sand; single grain; loose; strongly effervescent; about 25 percent gravel; mildly alkaline.

The thickness of the solum is typically 24 to 36 inches but ranges from 20 to 40 inches. The content of gravel ranges from 3 to 25 percent in the solum and 10 to 45 percent in the substratum. The content of cobbles ranges from 0 to 5 percent throughout the pedon.

The A horizon has hue of 7.5YR or 10YR, value of 2

or 3, and chroma of 1 or 2. Some pedons have an E horizon. This horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. It is loamy sand or gravelly sandy loam. The Bs horizon has hue of 7.5YR or 5YR, value of 3 to 5, and chroma of 4 to 6. It is sand, loamy sand, or gravelly loamy sand. The Bt horizon has hue of 7.5YR or 5YR and value and chroma of 3 or 4. It is sandy clay loam, sandy loam, loamy sand, or gravelly loamy sand. The C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. It is sand, very gravelly sand, gravelly sand, or coarse sand.

Manistee Series

The Manistee series consists of deep, well drained soils in glacial lake basins and on outwash plains. These soils formed predominantly in sandy deposits and in the underlying clayey or loamy lacustrine deposits. Permeability is rapid in the sandy upper part of the profile, very slow in the lower part of the subsoil, and slow in the substratum. Slope ranges from 2 to 6 percent.

Typical pedon of Manistee loamy sand, 2 to 6 percent slopes, approximately 500 feet south and 150 feet east of the northwest corner of sec. 8, T. 35 N., R. 18 E.

A—0 to 3 inches; dark brown (7.5YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; weak medium granular structure; very friable; many medium roots; very strongly acid; abrupt wavy boundary.

E—3 to 5 inches; brown (7.5YR 5/2) loamy sand, pinkish gray (7.5YR 7/2) dry; moderate medium subangular blocky structure; very friable; many medium roots; very strongly acid; abrupt wavy boundary.

Bs1—5 to 11 inches; reddish brown (5YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; many medium roots; very strongly acid; clear wavy boundary.

Bs2—11 to 17 inches; yellowish red (5YR 4/6) loamy sand; weak fine subangular blocky structure; very friable; many medium roots; strongly acid; gradual wavy boundary.

Bs3—17 to 25 inches; yellowish red (5YR 5/6) loamy sand; weak coarse subangular blocky structure; very friable; few fine roots; strongly acid; clear wavy boundary.

2B/E—25 to 28 inches; about 70 percent reddish brown (5YR 4/4) fine sandy loam (Bt); moderate medium subangular blocky structure; friable; penetrated by about 30 percent interfingers of reddish brown (5YR 5/4) loamy sand (E); moderate fine subangular blocky structure; very friable; few fine roots; medium acid; gradual wavy boundary.

2Bt—28 to 36 inches; reddish brown (2.5YR 4/4) clay; moderate medium subangular blocky structure; extremely firm; few fine roots; many faint continuous reddish brown (2.5YR 4/4) clay films on faces of peds; strongly acid; gradual wavy boundary.

2C—36 to 60 inches; reddish brown (2.5YR 4/4) clay; massive; extremely firm; neutral.

The thickness of the sandy mantle and the depth to clayey deposits range from 20 to 40 inches. The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 2 to 6. It is loamy sand, sand, or fine sand. The 2Bt horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 3 or 4. It is dominantly silty clay or clay but is clay loam in some pedons. The 2C horizon has hue of 5YR or 2.5YR, value of 4 to 6, and chroma of 3 or 4. It is dominantly silty clay or clay but is clay loam in some pedons.

Markey Series

The Markey series consists of deep, very poorly drained soils on outwash plains, stream terraces, and moraines. These soils formed in herbaceous organic material underlain by outwash or lacustrine sandy deposits. Permeability is moderately slow to moderately rapid in the organic material and rapid in the underlying sandy deposits. Slope is 0 to 1 percent.

Typical pedon of Markey muck, in an area of Seelyeville and Markey mucks, 0 to 1 percent slopes; approximately 1,600 feet south and 40 feet east of the northwest corner of sec. 4, T. 30 N., R. 23 E.

Oa1—0 to 16 inches; black (10YR 2/1), broken face and rubbed, sapric material; about 20 percent fiber, 4 percent rubbed; moderate medium subangular blocky structure; primarily herbaceous fibers; many fibrous roots; neutral (pH 7.2 by Truog method); abrupt smooth boundary.

Oa2—16 to 21 inches; very dark brown (10YR 2/2), broken face, sapric material, black (10YR 2/1) rubbed; about 15 percent fibers, 2 percent rubbed; moderate medium and thick platy structure; primarily herbaceous fibers; common fibrous roots; neutral (pH 6.8 by Truog method); abrupt smooth boundary.

C1—21 to 24 inches; very dark gray (10YR 3/1) fine

sand; weak medium subangular blocky structure; very friable; neutral; abrupt wavy boundary.
C2—24 to 60 inches; grayish brown (10YR 5/2) fine sand; many coarse prominent brownish yellow (10YR 6/6) mottles; single grain; loose; mildly alkaline.

The thickness of the organic material and the depth to the sandy 2C horizon range from 16 to 51 inches. Some pedons have as much as 10 inches of hemic material, some have as much as 5 inches of fibric material, and some have a layer of sphagnum moss on the surface. This layer is 1 to 4 inches thick. The C horizon is fine sand, sand, loamy sand, or coarse sand. The content of pebbles in this horizon is as much as 15 percent in some pedons.

Menahga Series

The Menahga series consists of deep, excessively drained, rapidly permeable soils on moraines, outwash plains, and stream terraces (fig. 23). These soils formed in sandy outwash deposits. Slope ranges from 0 to 25 percent.

Typical pedon of Menahga sand, 0 to 6 percent slopes, approximately 1,050 feet south and 790 feet east of the northwest corner of sec. 26, T. 35 N., R. 18 E.

A—0 to 2 inches; black (10YR 2/1) sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; many fine roots; strongly acid; abrupt smooth boundary.
E—2 to 3 inches; dark grayish brown (10YR 4/2) sand, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; many fine roots; strongly acid; abrupt wavy boundary.
Bw1—3 to 7 inches; dark brown (7.5YR 4/4) sand; weak fine subangular blocky structure; very friable; many fine roots; strongly acid; abrupt wavy boundary.
Bw2—7 to 14 inches; strong brown (7.5YR 4/6) sand; single grain; loose; few roots; medium acid; abrupt wavy boundary.
BC—14 to 25 inches; strong brown (7.5YR 5/6) sand; single grain; loose; few roots; slightly acid; abrupt wavy boundary.
C1—25 to 46 inches; yellowish brown (10YR 5/6) sand; single grain; loose; about 2 percent gravel; neutral; abrupt smooth boundary.
C2—46 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; about 2 percent gravel; neutral.

The thickness of the solum ranges from 20 to 32 inches. The content of gravel ranges from 0 to 12 percent in the subsoil and substratum.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The B horizon has hue of 7.5YR and 10YR, value of 4 or 5, and chroma of 4 to 6. It is dominantly sand but is fine sand, loamy sand, or coarse sand in some pedons. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 to 6. It is dominantly sand but is coarse sand or has thin strata of fine sand in some pedons.

Menominee Series

The Menominee series consists of deep, well drained soils on outwash plains and moraines. These soils formed in sandy deposits and in the underlying loamy till. Permeability is rapid in the sandy upper part of the profile and moderate in the loamy lower part of the subsoil and in the substratum. Slope ranges from 2 to 25 percent.

Typical pedon of Menominee loamy sand, 2 to 6 percent slopes, approximately 2,600 feet north and 70 feet east of the southwest corner of sec. 29, T. 32 N., R. 20 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; many fine roots; medium acid; abrupt smooth boundary.
Bs1—8 to 17 inches; brown (7.5YR 5/4) sand; weak coarse subangular blocky structure; very friable; few fine roots; medium acid; clear wavy boundary.
Bs2—17 to 30 inches; strong brown (7.5YR 5/6) sand; weak medium subangular blocky structure; very friable; few fine roots; medium acid; clear wavy boundary.
2E/B—30 to 36 inches; about 70 percent brown (7.5YR 5/4) loamy sand (E); moderate medium subangular structure; friable; about 30 percent tongues of E material extending into or completely surrounding isolated remnants of brown (7.5YR 4/4) loamy sand (Bt); moderate medium subangular blocky structure; friable; few medium roots; patchy brown (7.5YR 5/4) clay films on faces of peds; medium acid; clear irregular boundary.
2Bt—36 to 46 inches; brown (7.5YR 4/4) fine sandy

loam; weak and moderate medium subangular blocky structure; friable; few medium roots; few faint thin patchy brown (7.5YR 5/4) clay films on faces of peds; about 10 percent gravel; slightly acid; clear wavy boundary.

2BC—46 to 50 inches; strong brown (7.5YR 5/6) fine sandy loam; weak medium subangular blocky structure; friable; about 10 percent gravel; mildly alkaline; clear wavy boundary.

2C—50 to 60 inches; brown (7.5YR 5/4) fine sandy loam; massive; friable; slightly effervescent; about 12 percent gravel; mildly alkaline.

The thickness of the sandy mantle and the depth to loamy deposits range from 20 to 40 inches. The content of gravel ranges from 0 to 10 percent in the loamy part of the subsoil and from 0 to 15 percent in the substratum.

The Ap horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. Some pedons have an E horizon. This horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 2 or 3. The Bs horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is sand, loamy sand, fine sand, or loamy fine sand. In some pedons fragments of ortstein are in the Bs horizon. Some pedons have an E' horizon. This horizon has hue of 7.5YR, value of 5 or 6, and chroma of 4. In most pedons the E' material occurs as coatings on ped faces in the 2Bt horizon. The 2Bt horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 3 to 5. It is sandy loam, fine sandy loam, loam, sandy clay loam, or clay loam. The 2C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam, fine sandy loam, or loam.

Michigamme Series

The Michigamme series consists of moderately deep, well drained soils on moraines and outwash plains. These soils formed in loamy deposits underlain by igneous or metamorphic bedrock. Permeability is moderate. Slope ranges from 4 to 15 percent.

Typical pedon of Michigamme fine sandy loam, in an area of Michigamme-Rock outcrop complex, 4 to 15 percent slopes; approximately 1,750 feet north and 2,120 feet east of the southwest corner of sec. 27, T. 37 N., R. 20 E.

A—0 to 2 inches; black (5YR 2/1) fine sandy loam, very dark gray (5YR 3/1) dry; weak fine subangular blocky structure; very friable; many fine fibrous roots; very strongly acid; abrupt wavy boundary.

E—2 to 4 inches; reddish gray (5YR 5/2) fine sandy loam, pinkish gray (7.5YR 7/2) dry; weak very fine subangular blocky structure; very friable; many fine fibrous roots; very strongly acid; abrupt wavy boundary.

Bh—4 to 9 inches; dark reddish brown (5YR 3/3) fine sandy loam; weak fine subangular blocky structure; very friable; many fine fibrous roots; medium acid; clear wavy boundary.

Bs1—9 to 17 inches; reddish brown (5YR 4/4) fine sandy loam; weak fine subangular blocky structure; very friable; many fine roots; medium acid; clear wavy boundary.

Bs2—17 to 24 inches; brown (7.5YR 4/4) fine sandy loam; weak fine subangular blocky structure; very friable; few fine roots; medium acid; abrupt wavy boundary.

2R—24 inches; granite.

The thickness of the solum and the depth to granite range from 20 to 40 inches. The horizons below the A horizon are fine sandy loam, very fine sandy loam, or sandy loam.

The A horizon has hue of 5YR, 7.5YR, or 10YR; value of 2 or 3; and chroma of 1 or 2. The E horizon has hue of 5YR or 7.5YR and value of 4 to 6. The Bh horizon has value and chroma of 2 or 3. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 4 to 6. Some pedons have a C horizon. This horizon has hue of 2.5YR, 5YR, or 7.5YR; value of 4 or 5; and chroma of 3 to 5. It is fine sandy loam or sandy loam. The underlying bedrock is igneous or metamorphic.

Monico Series

The Monico series consists of deep, somewhat poorly drained, moderately permeable soils on ground moraines. These soils formed in loamy deposits and in the underlying loamy or sandy till. Slope ranges from 0 to 3 percent.

Typical pedon of Monico fine sandy loam, 0 to 3 percent slopes, approximately 1,700 feet south and 800 feet west of the northeast corner of sec. 18, T. 36 N., R. 17 E.

Oe—2 inches to 0; black (10YR 2/1) partially decomposed forest litter.

E—0 to 5 inches; pinkish gray (7.5YR 6/2) fine sandy loam, pinkish gray (7.5YR 7/2) dry; few fine prominent brownish yellow (10YR 6/6) mottles;

weak medium platy structure parting to weak very fine subangular blocky; friable; common fine horizontal roots; extremely acid; clear wavy boundary.

Bs1—5 to 8 inches; dark reddish brown (5YR 3/3) fine sandy loam; few fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; friable; common fine horizontal roots; few fine weakly cemented ortstein fragments; extremely acid; clear wavy boundary.

Bs2—8 to 12 inches; reddish brown (5YR 4/4) fine sandy loam; common fine prominent reddish yellow (7.5YR 6/6) mottles; weak fine subangular blocky structure; friable; common fine horizontal roots; strongly acid; clear wavy boundary.

Bs3—12 to 26 inches; reddish brown (5YR 5/3) fine sandy loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; friable; few fine horizontal roots; slightly acid; clear wavy boundary.

2BC—26 to 33 inches; brown (7.5YR 5/4) sandy loam; few fine prominent yellowish red (5YR 5/6) mottles; weak fine subangular blocky structure; friable; few fine horizontal roots; about 5 percent gravel; slightly acid; abrupt wavy boundary.

2C—33 to 60 inches; reddish brown (5YR 5/3) sandy loam; few fine distinct yellowish red (5YR 5/6) and common medium prominent reddish yellow (7.5YR 6/8) mottles; massive; friable; about 10 percent gravel; slightly acid.

The thickness of the solum ranges from 24 to 42 inches. The content of gravel ranges from 0 to 15 percent in the upper part of the profile and from 3 to 20 percent in the BC horizon and in the substratum. The content of cobbles ranges from 0 to 15 percent throughout the profile.

Some pedons have an A horizon. This horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. The E horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 or 3. It is silt loam, very fine sandy loam, or fine sandy loam. Some pedons do not have an E horizon. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is silt loam, very fine sandy loam, or fine sandy loam. The 2BC horizon has hue of 5YR, 7.5YR, or 10YR; value of 4 to 6; and chroma of 3 to 4. It is fine sandy loam, sandy loam, or the gravelly analogs of these textures. The 2C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam, loamy sand, or the gravelly analogs of these textures.

Moquah Series

The Moquah series consists of deep, moderately well drained soils on flood plains. These soils formed in loamy and sandy alluvial deposits. Permeability is moderately slow or moderate. Slope ranges from 0 to 2 percent.

Typical pedon of Moquah fine sandy loam, 0 to 2 percent slopes, approximately 800 feet east and 1,500 feet north of the southwest corner of sec. 3, T. 33 N., R. 21 E.

A—0 to 12 inches; very dark grayish brown (10YR 3/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; many fine roots; neutral; abrupt smooth boundary.

C1—12 to 30 inches; dark reddish brown (5YR 3/3) very fine sandy loam; moderate medium platy structure; very friable; neutral; abrupt smooth boundary.

C2—30 to 41 inches; reddish brown (5YR 4/4) fine sandy loam; moderate thick platy structure parting to moderate medium subangular blocky; very friable; slightly acid; abrupt smooth boundary.

C3—41 to 60 inches; reddish brown (5YR 4/4) stratified very fine sand and brown (7.5YR 5/4) fine sand; common medium prominent strong brown (7.5YR 5/6) mottles; very friable; mildly alkaline.

The color, arrangement, and thickness of horizons vary considerably. The A horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 1 to 3. The C horizon commonly has hue of 5YR, but hue is 7.5YR or 10YR in some pedons. Value is 3 to 5, and chroma is 3 to 6. The C1 and C2 horizons vary in texture and thickness. They are commonly fine sandy loam, very fine sandy loam, or sandy loam. The C3 horizon below a depth of about 40 inches is stratified sandy deposits or stratified sandy and loamy deposits.

Nadeau Series

The Nadeau series consists of deep, well drained soils on outwash plains, moraines, and eskers. These soils formed in loamy deposits underlain by calcareous sandy and very gravelly deposits (fig. 24). Permeability is moderate in the subsoil and very rapid in the substratum. Slope ranges from 2 to 12 percent.

Typical pedon of Nadeau fine sandy loam, 2 to 6 percent slopes, approximately 2,200 feet south and 1,300 feet east of the northwest corner of sec. 1, T. 35 N., R. 21 E.

A—0 to 1 inch; very dark gray (10YR 3/1) fine sandy

loam, gray (10YR 6/1) dry; weak fine granular structure; very friable; many fine roots; neutral; abrupt wavy boundary.

E—1 to 2 inches; brown (7.5YR 4/4) fine sandy loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; very friable; many fine roots; neutral; abrupt wavy boundary.

Bt1—2 to 14 inches; brown (7.5YR 5/4) fine sandy loam; moderate medium subangular blocky structure; very friable; few fine roots; about 5 percent gravel; neutral; abrupt wavy boundary.

2Bt2—14 to 20 inches; reddish brown (5YR 4/4) very gravelly sandy loam; moderate medium subangular blocky structure; friable; few fine roots; reddish brown (5YR 4/4) clay films on faces of peds and on pebbles; about 35 percent gravel and about 5 percent cobbles; mildly alkaline; abrupt wavy boundary.

2BC—20 to 27 inches; brown (7.5YR 5/4) very gravelly loamy sand; weak medium subangular blocky structure; very friable; about 35 percent gravel and 5 percent cobbles; mildly alkaline; abrupt wavy boundary.

2C—27 to 60 inches; pale brown (10YR 6/3) very gravelly sand; single grain; loose; strongly effervescent; about 40 percent gravel and 10 percent cobbles; mildly alkaline.

The thickness of the solum ranges from 12 to 30 inches. The content of gravel ranges from 0 to 15 percent in the upper part of the solum and from 30 to 60 percent in the lower part of the solum and in the substratum. The content of cobbles ranges from 0 to 3 percent in the upper part of the solum and from 3 to 25 percent in the lower part of the solum and in the substratum.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is loam or sandy loam. Some pedons do not have an E horizon. The Bt1 horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 4 or 5. It is fine sandy loam, loam, or sandy loam. The 2Bt horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 or 4. It is the very gravelly analogs of loam, fine sandy loam, or sandy loam. The 2B and 2C horizons have hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. They are very gravelly loamy sand or very gravelly sand.

Nahma Series

The Nahma series consists of moderately deep, very poorly drained soils on ground moraines. These soils formed in loamy till underlain by dolomite. Permeability is moderate. Slope ranges from 0 to 2 percent.

Typical pedon of Nahma muck, 0 to 2 percent slopes, approximately 920 feet south and 1,400 feet west of the northeast corner of sec. 9, T. 31 N., R. 22 E.

Oa—0 to 9 inches; black (7.5YR 2/0), broken face and rubbed, sapric material; weak medium subangular blocky structure; friable; many very fine and fine roots; neutral; abrupt smooth boundary.

Bg—9 to 13 inches; dark gray (10YR 4/1) loam; few fine faint grayish brown (10YR 5/2) and common fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very friable; common very fine and fine roots; neutral; clear smooth boundary.

Bw1—13 to 15 inches; brown (10YR 5/3) loam; few medium faint grayish brown (10YR 5/2) and common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few very fine roots; about 10 percent gravel; mildly alkaline; clear wavy boundary.

Bw2—15 to 21 inches; multicolored brown (10YR 5/3), yellowish brown (10YR 5/6), and pinkish gray (7.5YR 6/2) sandy loam; weak fine subangular blocky structure; friable; slightly effervescent; about 10 percent gravel; mildly alkaline; clear wavy boundary.

C—21 to 40 inches; multicolored reddish brown (5YR 5/3), strong brown (7.5YR 5/6), pale red (2.5YR 6/2), and light greenish gray (5G 7/1) fine sandy loam; weak medium subangular blocky structure; friable; strongly effervescent; about 10 percent gravel and 5 percent cobbles; mildly alkaline; abrupt smooth boundary.

2R—40 inches; dolomite.

The depth to dolomite ranges from 20 to 40 inches. The content of gravel ranges from 0 to 15 percent throughout the profile. The content of cobbles ranges from 0 to 12 percent throughout the profile.

The thickness of the Oa horizon ranges from 6 to 16 inches. Some pedons have an A horizon. This horizon has hue of 7.5YR or 10YR, value of 2, and chroma of 1 or 2, or it is neutral in hue and has value of 2. The Bg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. The Bw1 and Bw2 horizons have hue of 5YR, 7.5YR, or 10YR; value of 4 to 6; and chroma of 3 or 4. They are loam, sandy loam, or the gravelly analogs of these textures. The C horizon has hue of 5YR, 7.5YR, or 10YR; value of 4 or 5; and chroma of 1

to 6. It is fine sandy loam, sandy loam, or the gravelly analogs of these textures.

Padus Series

The Padus series consists of deep, well drained soils on outwash plains, stream terraces, kames, and moraines. These soils formed in loamy and sandy deposits underlain by noncalcareous, stratified sand or sand and gravel. Permeability is moderate or moderately rapid in the loamy upper part of the profile and rapid or very rapid in the sandy and gravelly lower part of the subsoil and in the substratum. Slope ranges from 1 to 25 percent.

Typical pedon of Padus fine sandy loam, 1 to 6 percent slopes, approximately 925 feet north and 1,720 feet east of the southwest corner of sec. 22, T. 37 N., R. 18 E.

A—0 to 1 inch; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; many very fine roots; very strongly acid; abrupt wavy boundary.

E—1 to 5 inches; brown (10YR 5/3) fine sandy loam, pinkish gray (7.5YR 7/2) dry; weak thin platy structure; very friable; many fine roots; medium acid; abrupt wavy boundary.

Bs—5 to 13 inches; brown (7.5YR 4/4) fine sandy loam; weak fine subangular blocky structure; very friable; few fine and very fine roots; medium acid; clear wavy boundary.

E'—13 to 20 inches; brown (7.5YR 5/4) fine sandy loam; weak medium subangular blocky structure; very friable; few fine roots; medium acid; clear wavy boundary.

Bt—20 to 24 inches; reddish brown (5YR 5/4) sandy loam; weak fine subangular blocky structure; very friable; few fine roots; common faint patchy reddish brown (5YR 4/4) clay films on faces of peds; about 2 percent gravel; medium acid; clear wavy boundary.

2BC—24 to 27 inches; reddish brown (5YR 5/3) loamy sand; weak fine subangular blocky structure; very friable; few fine roots; about 2 percent gravel; slightly acid; abrupt wavy boundary.

2C1—27 to 35 inches; strong brown (7.5YR 5/6) sand; single grain; loose; about 2 percent gravel; slightly acid; abrupt smooth boundary.

2C2—35 to 60 inches; reddish brown (5YR 4/4), stratified sand and gravelly sand; single grain; loose; about 16 percent gravel; slightly acid.

The thickness of the solum commonly ranges from 24 to 40 inches. The thickness of the loamy mantle ranges from 20 to 35 inches. The content of gravel ranges from 0 to 10 percent in the loamy mantle and from 0 to 40 percent in the lower part of the subsoil and in the substratum. The content of cobbles ranges from 0 to 40 percent throughout the profile.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 or 3. It is silt loam, sandy loam, or fine sandy loam. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is sandy loam, fine sandy loam, or loam. Some pedons have a Bhs horizon. This horizon has colors and textures similar to those of the Bs horizon. The E' horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. It is loamy fine sand, sandy loam, fine sandy loam, or loam. The Bt horizon has hue of 5YR or 7.5YR and value and chroma of 3 to 5. It is loam or sandy loam. The 2BC horizon has hue of 5YR or 7.5YR and value of 4 or 5. It is loamy sand, sandy loam, sand, or the gravelly analogs of these textures. The 2C horizon is sand, gravelly sand, or stratified sand and gravelly sand.

Pence Series

The Pence series consists of deep, well drained soils on outwash plains, stream terraces, and moraines. These soils formed in loamy and sandy deposits underlain by noncalcareous sand or sand and gravel. Permeability is moderately rapid in the loamy upper part of the profile and rapid or very rapid in the substratum. Slope ranges from 1 to 35 percent.

Typical pedon of Pence sandy loam, 1 to 6 percent slopes, approximately 530 feet south and 2,400 feet west of the northeast corner of sec. 18, T. 37 N., R. 20 E.

A—0 to 1 inch; black (10YR 2/1) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; common fine roots; about 2 percent gravel; medium acid; abrupt wavy boundary.

E—1 to 2 inches; dark brown (7.5YR 4/2) sandy loam, pinkish gray (7.5YR 6/2) dry; moderate fine subangular blocky structure; very friable; common fine horizontal roots; about 2 percent gravel; medium acid; abrupt wavy boundary.

Bs1—2 to 7 inches; dark reddish brown (5YR 3/4) sandy loam; weak medium subangular blocky structure; very friable; common fine vertical roots;

about 2 percent gravel; medium acid; clear wavy boundary.

Bs2—7 to 14 inches; reddish brown (5YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; few fine vertical roots; about 2 percent gravel; slightly acid; abrupt smooth boundary.

2BC—14 to 21 inches; strong brown (7.5YR 4/6) gravelly sand; weak medium subangular blocky structure; very friable; about 15 percent gravel; slightly acid; clear wavy boundary.

2C—21 to 60 inches; light yellowish brown (10YR 6/4) gravelly sand; single grain; loose; about 17 percent gravel; slightly acid.

The thickness of the solum ranges from 16 to 24 inches. The thickness of the loamy mantle ranges from 12 to 20 inches. The content of gravel ranges from 0 to 10 percent in the solum and from 10 to 35 percent in the substratum. The content of cobbles ranges from 0 to 5 percent in the solum and from 0 to 10 percent in the substratum.

The Ap horizon has hue of 7.5YR or 10YR, value of 2 to 4, and chroma of 1 or 2. The E horizon has hue of 5YR or 7.5YR and value of 4 to 6. The Bs1 horizon has hue of 5YR or 7.5YR and value and chroma of 3 or 4. The Bs2 horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 2 to 6. The Bs1 and Bs2 horizons are sandy loam, fine sandy loam, or loam. The 2BC horizon has hue of 5YR or 7.5YR and value and chroma of 4 to 8. It is sand, coarse sand, or the gravelly analogs of these textures. The 2C horizon has hue of 5YR, 7.5YR, or 10YR; value of 4 to 6; and chroma of 2 to 6. It is sand, coarse sand, gravelly sand, or stratified sand and gravel.

Pickford Series

The Pickford series consists of deep, poorly drained, very slowly permeable soils in glacial lake basins and on moraines. These soils formed in thin deposits of silty material and in the underlying clayey lacustrine deposits. Slope ranges from 0 to 2 percent.

The Pickford soils in Marinette County have a thicker dark surface layer than is defined as the range for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Typical pedon of Pickford mucky silty clay loam, 0 to 2 percent slopes, approximately 2,400 feet north and 560 feet west of the southeast corner of sec. 27, T. 37 N., R. 18 E.

A—0 to 6 inches; very dark gray (10YR 3/1) mucky silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; firm; many fine and medium roots; about 15 percent organic matter; neutral; abrupt smooth boundary.

Eg—6 to 12 inches; dark gray (10YR 4/1) silty clay loam, light brownish gray (10YR 6/2) dry; weak coarse subangular blocky structure; firm; slightly acid; clear wavy boundary.

Bg—12 to 20 inches; dark reddish gray (5YR 4/2) silty clay loam, few fine prominent strong brown (7.5YR 5/8) and few medium faint gray (5YR 5/1) mottles; weak coarse subangular blocky structure; firm; neutral; clear wavy boundary.

C1—20 to 28 inches; weak red (2.5YR 4/2) silty clay; common medium distinct dark red (2.5YR 3/6) mottles; massive; firm; neutral; clear wavy boundary.

C2—28 to 60 inches; weak red (2.5YR 4/2) silty clay; common medium prominent reddish yellow (7.5YR 6/6) mottles; massive; firm; strongly effervescent; mildly alkaline.

The depth to carbonates ranges from 14 to 30 inches. The A horizon has hue of 5YR, 7.5YR, or 10YR and value of 2 or 3. The Eg horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 1 or 2. It is silty clay loam or silty clay. The Bg horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 1 or 2. It is clay, silty clay, or silty clay loam. The C horizon has hue of 2.5YR, 5YR, or 7.5YR; value of 4 or 5; and chroma of 2 or 3. It is silty clay or clay.

Pinconning Series

The Pinconning series consists of deep, poorly drained and very poorly drained soils in glacial lake basins and on outwash plains. These soils formed in sandy deposits underlain by clayey or silty lacustrine deposits. Permeability is rapid in the sandy upper part of the profile and slow or very slow in the clayey or silty lower part. Slope ranges from 0 to 2 percent.

Typical pedon of Pinconning loamy sand, 0 to 2 percent slopes, approximately 2,200 feet south and 1,020 feet east of the northwest corner of sec. 26, T. 37 N., R. 18 E.

A—0 to 8 inches; black (10YR 2/1) loamy sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; many fine fibrous roots; slightly acid; abrupt smooth boundary.

Cg—8 to 15 inches; dark grayish brown (10YR 4/2) sand; common medium prominent strong brown

(7.5YR 5/6) mottles; weak coarse subangular blocky structure; very friable; many fibrous roots; matrix color is of uncoated sand grains; slightly acid; abrupt smooth boundary.

C1—15 to 27 inches; brown (10YR 4/3) sand; common coarse distinct yellowish brown (10YR 5/6) mottles; single grain; loose; matrix color is of uncoated sand grains; neutral; abrupt smooth boundary.

2C2—27 to 60 inches; reddish brown (5YR 4/4 and 5/3) silty clay; common medium prominent grayish brown (10YR 5/2) mottles; massive; firm; strongly effervescent; mildly alkaline.

The thickness of the sandy mantle and the depth to clayey 2C material range from 20 to 40 inches. The A horizon has value of 2 or 3. The Cg horizon has value of 3 to 6 and chroma of 1 or 2. The C1 horizon has value of 4 to 6 and chroma of 2 to 4. The 2C2 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 2 to 4. It is silty clay or clay, but in some pedons it is silty clay loam.

Roscommon Series

The Roscommon series consists of deep, poorly drained and very poorly drained, rapidly permeable soils on outwash plains and moraines. These soils formed in sandy outwash deposits. Slope ranges from 0 to 2 percent.

Typical pedon of Roscommon mucky loamy sand, 0 to 2 percent slopes, approximately 1,290 feet south and 1,600 feet east of the northwest corner of sec. 18, T. 30 N., R. 23 E.

A—0 to 7 inches; black (10YR 2/1) mucky loamy sand, dark gray (10YR 4/1) dry; weak medium and coarse subangular blocky structure; very friable; common roots; slightly acid; abrupt smooth boundary.

C1—7 to 12 inches; light brownish gray (10YR 6/2) sand; single grain; loose; matrix color is of uncoated sand grains; neutral; abrupt smooth boundary.

C2—12 to 20 inches; grayish brown (10YR 5/2) sand; single grain; loose; matrix color is of uncoated sand grains; neutral; abrupt smooth boundary.

C3—20 to 60 inches; grayish brown (2.5Y 5/2) sand; single grain; loose; matrix color is of uncoated sand grains; neutral.

The content of gravel ranges from 0 to 10 percent throughout the profile. The C horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 5 or 6; and chroma of 2 to 4. It is dominantly sand but has layers of loamy sand, fine sand, or coarse sand in some pedons.

Rousseau Series

The Rousseau series consists of deep, moderately well drained soils on outwash plains and in glacial lake basins. These soils formed in deposits of sandy material, which is predominantly fine sand in size. Permeability is moderately rapid or rapid. Slope ranges from 1 to 6 percent.

Typical pedon of Rousseau loamy fine sand, 1 to 6 percent slopes, approximately 2,600 feet south and 2,240 feet west of the northeast corner of sec. 25, T. 30 N., R. 23 E.

A—0 to 2 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many fine and very fine roots; medium acid; abrupt smooth boundary.

E—2 to 6 inches; gray (10YR 5/1) fine sand, light gray (10YR 7/1) dry; weak fine subangular blocky structure; very friable; many fine roots; medium acid; abrupt wavy boundary.

Bs1—6 to 9 inches; dark reddish brown (5YR 3/4) fine sand; weak medium subangular blocky structure; loose; few fine roots; strongly acid; gradual wavy boundary.

Bs2—9 to 16 inches; dark brown (7.5YR 4/4) fine sand; single grain; loose; medium acid; gradual wavy boundary.

BC—16 to 32 inches; brown (7.5YR 5/4) fine sand; single grain; loose; medium acid; gradual wavy boundary.

C1—32 to 48 inches; brown (7.5YR 5/4) fine sand; common medium distinct strong brown (7.5YR 5/8) mottles; single grain; loose; medium acid; gradual wavy boundary.

C2—48 to 60 inches; brown (10YR 5/3) fine sand; common medium prominent strong brown (7.5YR 5/6) mottles; single grain; loose; slightly acid.

The thickness of the solum ranges from 20 to 32 inches. The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 or 2. It is fine sand or loamy fine sand. The Bs1 horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. Some pedons have weak cementation or iron concretions in this horizon. The Bs2 horizon has hue of 5YR or 7.5YR and value and chroma of 4 to 6. The BC horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 6. In some pedons this horizon is mottled. The C horizon has hue of 7.5YR or 10YR,

value of 5 or 6, and chroma of 3 to 6. It is fine sand or sand.

Sarona Series

The Sarona series consists of deep, well drained, moderately permeable soils on moraines. These soils formed predominantly in loamy deposits and in the underlying loamy or sandy till. Slope ranges from 2 to 35 percent.

Typical pedon of Sarona fine sandy loam, 2 to 6 percent slopes, approximately 200 feet north and 1,520 feet east of the southwest corner of sec. 26, T. 37 N., R. 17 E.

Oi—½ inch to 0; mat of undecomposed leaves and twigs.

A—0 to 4 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; many fine and medium roots; about 5 percent gravel; strongly acid; clear smooth boundary.

E—4 to 6 inches; pinkish gray (7.5YR 6/2) fine sandy loam, pinkish gray (7.5YR 7/2) dry; moderate thin platy structure; friable; many fine and medium roots; about 5 percent gravel; medium acid; clear smooth boundary.

Bs1—6 to 9 inches; strong brown (7.5YR 4/6) fine sandy loam; moderate fine subangular blocky structure; friable; common fine and medium roots; medium acid; clear wavy boundary.

Bs2—9 to 28 inches; brown (7.5YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; common fine and medium roots; slightly acid; clear wavy boundary.

B/E—28 to 31 inches; about 70 percent yellowish red (5YR 4/6) sandy loam (Bt); about 30 percent tongues of brown (7.5YR 5/4) sandy loam (E); moderate medium subangular blocky structure; friable; few fine roots; about 5 percent gravel; medium acid; clear wavy boundary.

Bt—31 to 34 inches; reddish brown (5YR 4/4) sandy loam; strong fine subangular blocky structure; firm; faint reddish brown (5YR 4/3) continuous clay films on faces of peds; few brown (7.5YR 5/4) coatings mostly on vertical faces of peds; about 5 percent gravel; medium acid; clear wavy boundary.

BC—34 to 38 inches; dark brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; few faint patchy reddish brown (5YR 4/3) clay films on vertical faces of peds; about 10 percent gravel; slightly acid; clear wavy boundary.

C—38 to 60 inches; strong brown (7.5YR 4/6) loamy sand; massive; friable; about 12 percent gravel; slightly acid.

The thickness of the solum ranges from 30 to 50 inches. The content of gravel ranges from 0 to 10 percent in the upper part of the solum and from 3 to 20 percent in the lower part of the solum and in the substratum.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 to 3. The E horizon has hue of 5YR, 10YR, or 7.5YR; value of 4 to 6; and chroma of 2 or 3. It is fine sandy loam, silt loam, very fine sandy loam, sandy loam, or loamy sand. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is fine sandy loam, sandy loam, or very fine sandy loam. Some pedons have an E′ horizon. This horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is sandy loam, loamy sand, fine sandy loam, or loam. The B/E horizon is cemented in some pedons. The Bt horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 3 to 6. It is sandy loam, loam, or the gravelly analogs of these textures. The BC horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is sandy loam, loamy sand, sand, or the gravelly analogs of these textures. The 2C horizon is variable in color but generally has hue of 5YR or 7.5YR and value and chroma of 4 to 6. It is sandy loam, loamy sand, or the gravelly analogs of these textures.

Sayner Series

The Sayner series consists of deep, excessively drained soils on outwash plains and moraines. These soils formed in sandy deposits and in the underlying noncalcareous gravelly sand outwash or stratified sand and gravel. Permeability is moderately rapid in the subsoil and rapid or very rapid in the substratum. Slope ranges from 1 to 15 percent.

Typical pedon of Sayner loamy sand, 6 to 15 percent slopes, approximately 2,510 feet north and 1,840 feet east of the southwest corner of sec. 13, T. 34 N., R. 19 E.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; many fine fibrous roots; medium acid; abrupt wavy boundary.

Bs1—3 to 11 inches; brown (7.5YR 4/4) loamy sand; weak fine and medium subangular blocky structure; very friable; common fine roots; about 5 percent

gravel; slightly acid; abrupt wavy boundary.

Bs2—11 to 25 inches; strong brown (7.5YR 4/6) gravelly sand; weak medium subangular blocky structure; very friable; few fine roots; about 15 percent gravel; slightly acid; abrupt wavy boundary.

C—25 to 60 inches; brown (7.5YR 5/4) gravelly sand; single grain; loose; about 20 percent gravel and 3 percent cobbles; slightly acid.

The thickness of the solum ranges from 15 to 32 inches. The content of gravel ranges from 0 to 15 percent in the A horizon, 0 to 25 percent in the B horizon, and 10 to 35 percent in the C horizon. The content of cobbles ranges from 0 to 10 percent throughout the profile.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. Some pedons have an E horizon. This horizon has hue of 10YR, 7.5YR, or 5YR; value of 4 to 6; and chroma of 2 or 3. It is sand or loamy sand. The Bs1 horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 2 to 4. The Bs2 horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 3 to 6. The Bs1 and Bs2 horizons are loamy sand, sand, or the gravelly analogs of these textures. Some pedons have a BC horizon. This horizon has colors and textures similar to those of the Bs2 horizon. The C horizon has hue of 10YR, 7.5YR, or 5YR and value and chroma of 4 to 6. It is stratified sand and gravel or gravelly sand.

Seelyeville Series

The Seelyeville series consists of deep, very poorly drained soils in glacial lake basins and on moraines and outwash plains. These soils formed in herbaceous organic material. Permeability is moderately slow to moderately rapid. Slope is 0 to 1 percent.

Typical pedon of Seelyeville muck, in an area of Seelyeville and Markey mucks, 0 to 1 percent slopes; approximately 30 feet north and 1,770 feet west of the southeast corner of sec. 20, T. 32 N., R. 20 E.

Oa1—0 to 12 inches; very dark brown (10YR 2/2), broken face, sapric material, black (10YR 2/1) rubbed; about 35 percent fiber, 5 percent rubbed; weak fine subangular blocky structure; herbaceous fibers; many fine fibrous roots; medium acid (pH 6.0 by Truog method); clear wavy boundary.

Oa2—12 to 30 inches; very dark brown (10YR 2/2), broken face, sapric material, black (10YR 2/1) rubbed; about 40 percent fiber, 10 percent rubbed; weak fine subangular blocky structure; herbaceous fibers; few fine roots; medium acid (pH 6.0 by Truog method); clear wavy boundary.

Oa3—30 to 48 inches; black (10YR 2/1), broken face, sapric material, black (7.5YR 2/0) rubbed; about 10 percent fiber, 2 percent rubbed; weak fine subangular blocky structure; herbaceous fibers; few fine roots; medium acid (pH 6.0 by Truog method); gradual irregular boundary.

Oa4—48 to 60 inches; black (10YR 2/1), broken face and rubbed, sapric material; about 20 percent fiber, 5 percent rubbed; massive; herbaceous fibers; few medium roots; medium acid (pH 6.0 by Truog method).

The thickness of the organic material is more than 51 inches. The fibers are derived primarily from herbaceous plants, but woody fibers are commonly in the upper layers. Some pedons have hemic layers, which are mostly less than 10 inches thick. Some pedons have limnic layers in the lower part of the profile.

Selkirk Series

The Selkirk series consists of deep, somewhat poorly drained, slowly permeable soils in glacial lake basins. These soils formed in thin deposits of silty material and in the underlying clayey lacustrine deposits. Slope ranges from 0 to 3 percent.

Typical pedon of Selkirk silt loam, 0 to 3 percent slopes, approximately 600 feet south and 1,400 feet east of the northwest corner of sec. 8, T. 35 N., R. 18 E.

A—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; many fine fibrous roots; medium acid; abrupt smooth boundary.

E—7 to 10 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; few medium prominent reddish yellow (7.5YR 6/8) mottles; moderate medium subangular blocky structure; friable; many fine fibrous roots; medium acid; abrupt wavy boundary.

B/E—10 to 13 inches; about 80 percent brown (7.5YR 5/4) silty clay loam (Bt); common medium distinct reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; friable; about 20 percent tongues of grayish brown (10YR 5/2) silty clay loam (E) penetrating from above; few fine roots; medium acid; abrupt wavy boundary.

Bt1—13 to 22 inches; reddish brown (2.5YR 4/4) silty

clay; few fine prominent strong brown (7.5YR 5/8) and brown (7.5YR 5/2) mottles; strong fine subangular blocky structure; firm; few fine roots; many faint continuous dark reddish brown (2.5YR 3/4) clay films on faces of peds; medium acid; abrupt wavy boundary.

Bt2—22 to 28 inches; reddish brown (2.5YR 4/4) silty clay; few fine prominent strong brown (7.5YR 5/8) and brown (7.5YR 5/2) mottles; strong medium subangular blocky structure; firm; few faint reddish brown (2.5YR 4/4) clay films on faces of peds; neutral; abrupt smooth boundary.

C—28 to 60 inches; reddish brown (2.5YR 4/4) silty clay; few faint prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; silt strata as much as ¼ inch thick; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 16 to 30 inches. The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 or 3. It is silt loam, silty clay loam, or silty clay. The Bt horizon has hue of 2.5YR, 5YR, or 7.5YR; value of 4 or 5; and chroma of 3 or 4. It is silty clay or clay. The C horizon has hue of 2.5YR, 5YR, or 7.5YR; value of 3 to 5; and chroma of 2 to 6. It is silty clay or clay.

Shawano Series

The Shawano series consists of deep, excessively drained, rapidly permeable soils on outwash plains and in glacial lake basins (fig. 25). These soils formed in deposits of sandy material, which is predominantly fine sand in size. Slope ranges from 2 to 30 percent.

Typical pedon of Shawano loamy fine sand, 2 to 6 percent slopes, approximately 275 feet north and 395 feet west of the southeast corner of sec. 29, T. 30 N., R. 23 E.

A—0 to 2 inches; very dark brown (10YR 2/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; many fine roots; very strongly acid; abrupt smooth boundary.

BA—2 to 4 inches; dark brown (10YR 3/3) fine sand; weak medium subangular blocky structure; very friable; many fine roots; strongly acid; abrupt smooth boundary.

Bw1—4 to 11 inches; brown (7.5YR 4/4) fine sand; single grain; loose; common fine roots; slightly acid; clear wavy boundary.

Bw2—11 to 26 inches; strong brown (7.5YR 5/6) fine sand; single grain; loose; common fine roots; slightly acid; clear wavy boundary.

C—26 to 60 inches; brown (7.5YR 5/4) fine sand; single grain; loose; slightly acid.

The thickness of the solum ranges from 18 to 32 inches. The depth to free carbonates is 60 inches or more.

The A horizon has hue of 10YR or 7.5YR and value and chroma of 2 to 4. The Bw horizon has value and chroma of 4 to 6. The C horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 to 6. It is predominantly fine sand, but it has strata of sand or very fine sand in some pedons.

Summerville Series

The Summerville series consists of shallow, well drained, moderately permeable soils on ground moraines. These soils formed in loamy till underlain by dolomite. Slope ranges from 1 to 12 percent.

The Summerville soils in Marinette County have a thicker dark surface layer than is defined as the range for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Typical pedon of Summerville fine sandy loam, 1 to 6 percent slopes, approximately 100 feet south and 2,000 feet west of the northeast corner of sec. 29, T. 31 N., R. 22 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) fine sandy loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; friable; common fine roots; mildly alkaline; abrupt smooth boundary.

Bw1—9 to 11 inches; dark reddish brown (5YR 3/4) fine sandy loam; moderate medium subangular blocky structure; friable; common fine roots; mildly alkaline; abrupt wavy boundary.

Bw2—11 to 15 inches; brown (7.5YR 4/4) loam; weak medium subangular blocky structure; very friable; common fine roots; moderately alkaline; abrupt smooth boundary.

BC—15 to 17 inches; strong brown (7.5YR 5/6) fine sandy loam; weak medium subangular blocky structure; very friable; common fine roots; moderately alkaline; abrupt wavy boundary.

2R—17 inches; dolomite.

The thickness of the solum and the depth to dolomite range from 10 to 20 inches. The content of gravel ranges from 0 to 7 percent throughout the profile. The content of cobbles ranges from 0 to 7 percent in the A or Ap horizon and from 0 to 10 percent in the B horizon.

The Ap horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 to 3. Some pedons have an A horizon. This horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The Bw horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is loam, sandy loam, or fine sandy loam.

Wainola Series

The Wainola series consists of deep, somewhat poorly drained, rapidly permeable soils on outwash plains and ground moraines and in glacial lake basins. These soils formed in deposits of sandy material, which is predominantly fine sand in size. Slope ranges from 0 to 3 percent.

Typical pedon of Wainola loamy fine sand, 0 to 3 percent slopes, approximately 2,540 feet north and 200 feet east of the southwest corner of sec. 17, T. 30 N., R. 24 E.

Oe—½ inch to 0; black (10YR 2/1) mat of partially decomposed leaves and stems.

A—0 to 2 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; moderate fine granular structure; very friable; many fine roots; many uncoated sand grains; strongly acid; abrupt smooth boundary.

E—2 to 5 inches; brown (7.5YR 5/2) fine sand, pinkish gray (7.5YR 6/2) dry; weak medium platy structure; very friable; many fine roots; strongly acid; abrupt wavy boundary.

Bs1—5 to 9 inches; brown (7.5YR 4/4) loamy fine sand; few medium prominent yellowish red (5YR 5/6) mottles; weak fine subangular blocky structure; very friable; many fine and medium roots; few iron concretions; strongly acid; clear wavy boundary.

Bs2—9 to 18 inches; brown (7.5YR 4/4) fine sand; many medium prominent yellowish red (5YR 4/6 and 5/6) and reddish gray (5YR 5/2) mottles; weak medium subangular blocky structure; very friable; many medium and fine roots; medium acid; clear wavy boundary.

BC—18 to 33 inches; brown (7.5YR 5/4) fine sand; many medium distinct pinkish gray (7.5YR 6/2), brown (7.5YR 4/4), and strong brown (7.5YR 4/6) mottles; weak coarse subangular blocky structure; very friable; many fine roots; many dark iron and manganese concretions; neutral; gradual wavy boundary.

C—33 to 60 inches; brown (7.5YR 5/4) fine sand; many medium distinct pinkish gray (7.5YR 6/2) and strong brown (7.5YR 5/6) mottles; massive; very friable; neutral.

The thickness of the solum ranges from 18 to 34 inches. The profile is predominantly fine sand but in some pedons is very fine sand or has thin strata of loamy fine sand.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The Bs1 horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. Distinct or prominent mottles are in the upper part of this horizon. The Bs2 horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The BC horizon has colors similar to those of the Bs horizon. The C horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 or 4.

Worcester Series

The Worcester series consists of deep, somewhat poorly drained soils on outwash plains and ground moraines. These soils formed in loamy deposits underlain by outwash sand or sand and gravel. Permeability is moderate in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 3 percent.

These soils have mottles in the upper part of the subsoil and are slightly wetter than is defined as the range for the Worcester series. This difference, however, does not alter the usefulness or behavior of the soils.

Typical pedon of Worcester fine sandy loam, 0 to 3 percent slopes, approximately 800 feet north and 450 feet west of the southeast corner of sec. 21, T. 36 N., R. 17 E.

A—0 to 2 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; moderate medium granular structure; very friable; many fine fibrous roots; very strongly acid; abrupt smooth boundary.

E—2 to 6 inches; grayish brown (10YR 5/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; very friable; many fine fibrous roots; very strongly acid; abrupt wavy boundary.

Bhs—6 to 11 inches; dark brown (7.5YR 3/4) fine sandy loam; few fine prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; very friable; common fine roots; very strongly acid; abrupt wavy boundary.

Bs—11 to 15 inches; brown (7.5YR 4/4) fine sandy

loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; very friable; common fine roots; medium acid; gradual irregular boundary.

E/B—15 to 24 inches; about 60 percent brown (7.5YR 5/4) fine sandy loam (E) that completely surrounds isolated remnants (about 40 percent) of strong brown (7.5YR 4/6) fine sandy loam (Bt); many medium distinct yellowish brown (10YR 5/6) and dark brown (10YR 4/3) mottles; moderate medium subangular blocky structure; very friable; slightly acid; clear wavy boundary.

Bt—24 to 30 inches; reddish brown (5YR 4/4) sandy loam; common fine distinct strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; very friable; few faint reddish brown (5YR 4/4) patchy clay bridging between sand grains; slightly acid; abrupt smooth boundary.

2C—30 to 60 inches; yellowish brown (10YR 5/4) sand; few fine distinct yellowish brown (10YR 5/8) mottles; single grain; loose; about 5 percent gravel; slightly acid.

The thickness of the solum ranges from 24 to 40 inches. The content of gravel ranges from 0 to 10 percent in the upper part of the solum and 0 to 40 percent in the lower part of the solum and in the substratum. The content of cobbles ranges from 0 to 5 percent throughout the profile.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 or 3. The Bhs and Bs horizons have hue of 7.5YR or 5YR and value and chroma of 3 or 4. They are sandy loam, fine sandy loam, or loam. The E part of the E/B horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. The Bt part has hue of 5YR or 7.5YR and value and chroma of 3 to 6. The E/B horizon is sandy loam, fine sandy loam, or loam. The Bt horizon has hue of 5YR or 7.5YR and value and chroma of 3 to 5. It is sandy loam, loam, or the gravelly analogs of these textures. The 2C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. It is sand, gravelly sand, or very gravelly sand.

Formation of the Soils

This section describes the geology and underlying material in Marinette County, relates the factors of soil formation to the soils of the county, and explains the processes of soil formation.

Geology and Underlying Material

Robert N. Cheetham, Jr., geologist, Soil Conservation Service, helped prepare this section.

Marinette County is underlain by igneous, metamorphic, and sedimentary rock. A bedrock geology map of Wisconsin shows the rock types and their distribution *(11)*. This information is based on published and unpublished geologic reports, well logs from a geologic survey, and a limited field check of the outcrops by a Soil Conservation Service geologist.

The bedrock is overlain by glacial deposits, which range in thickness from 0 to 350 feet. The northwestern half of the county is underlain by complexly folded and faulted Precambrian igneous and metamorphic rock worn down to a southeast-sloping plain with some surface irregularities. Two prominent quartzite knobs, or hills, McCaslin Mountain and Thunder Mountain, protrude through the glacial deposits.

Between the northwestern and the southeastern parts of the county is a narrow area underlain by Upper Cambrian sandstone. The southeastern part of the county is underlain by rocks formed from marine sediments of Ordovician age. There are few outcrops. There is a cuestalike trend from northeast to southwest that has a fairly well defined topographic scarp with outcrops and several sandstone and calcitic-dolomite quarries.

The irregular Precambrian rock surface is mostly covered by glacial deposits. In some areas, however, greenstone and granite crop out and the topography is bedrock controlled. In Pembine Township there are numerous greenstone ledges with thin ground moraine deposits between the rock ledges. The dominant rock is red to gray and gray-green granite associated with the Wolf River Batholith, granite intrusions into older rock, and metavolcanics and metasediments, such as quartzite, chert, and slate. Greenstones, gneiss, and schist are metamorphic rocks marginal to the granite and of greater age. Major faults or tectonic boundaries are concentrated in the northern one-fifth of the county. The major alignment of these features is from east to west. The Paleozoic rocks in the southeastern part of the county unconformably overlie the Precambrian rock. The Upper Cambrian sandstone with minor units of shale, dolomite, and conglomerate is overlapped to the east by the Prairie du Chien group of calcitic-dolomites, sandy dolomites, and a narrow belt of less resistant sandstone and shale, the Ancell group, and St. Peter sandstone and Glenwood shale. The youngest group of marine sediments are the Sinnipee group, which includes dolomite with some shale, and the Platteville, Decorah, and Galena Formations.

The Paleozoic rock is oriented in a northeast-to-southwest trend and dips southeast about 15 feet per mile. Unless slumped or differentially settled, outcrops appear almost horizontal. Probably, some minor folds or flexures could be observed if the bedrock were not obscured by glacial debris.

Quaternary deposits consist of recent soils; alluvium; beach sands; colluvium; windblown silts, which are underlain by Late Wisconsinan till; outwash sand and gravel; and glaciolacustrine deposits.

Ice from the Late Wisconsinan Green Bay Lobe advanced south and south-southwest, with numerous halts and oscillations *(10)*. The glacier left two end moraine till accumulations that are prominent but discontinuous. The Green Bay Lobe formed the Mountain Moraine in the western part of the county, which is aligned in a nearly north-south direction. The end moraines disappear beneath outwash deposits in Dunbar Township.

Abutting the Mountain Moraine to the west are tills from the Langlade ice lobe and a roughly triangular interlobate area of pitted outwash. The marginal moraine of the Langlade Lobe is called the Bowler Moraine. It runs diagonally across Silver Cliff Township.

The several eskers that trend from northeast to southwest are roughly parallel but discontinuous.

Eskers are poorly sorted, ridged sand and gravel deposits with flat tops. They were subglacial stream deposits confined by ice walls. In many areas they are opened up as pits and used as a source of sand and gravel. Some of the best examples of eskers are south and east of the village of Loomis, in Lake Township.

From the shoreline of Green Bay and extending inland for several miles are glaciolacustrine sands mixed with some silty clay and gravel lenses. These materials are beach sands and bottom sediments deposited during the existence of glacial Lake Oshkosh. The sediments may be partially eroded and overlain by windblown sands and by peat in some small areas.

Factors of Soil Formation

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineral composition of the parent material, the climate under which the soil material has accumulated and existed since accumulation, the plant and animal life on and in the soil, the relief and drainage, and the length of time that the forces of soil formation have acted on the soil material.

Climate and vegetation are active factors of soil formation. They act on the parent material that has accumulated through the weathering or physical disintegration of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant life are conditioned by relief. The parent material affects the kind of soil profile that forms and in some areas determines it almost entirely. Finally, time is needed for the transformation of the parent material into a soil. Some time is always needed for the differentiation of soil horizons. Usually, a long time is needed for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effects of any one factor unless conditions are specified for the other four.

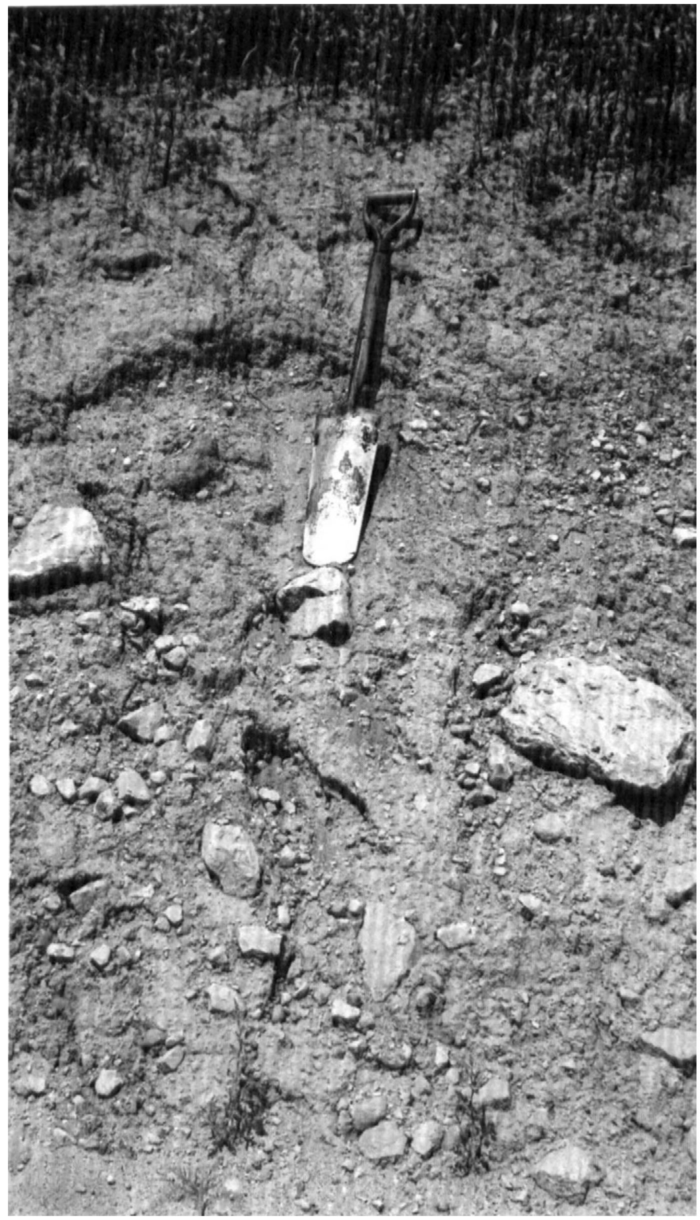

Figure 26.—A road cut showing the sandy loam glacial till that underlies most areas of the Emmet soils. The spade is approximately 3½ feet long.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It largely determines the chemical and mineralogical composition of the soil. Glacial till and outwash are the dominant kinds of parent material in the county. Lacustrine deposits and organic material also are common. Some soils formed in more than one kind of parent material.

Glacial till is unstratified, unsorted glacial debris made up mainly of clay, silt, and sand. It may contain gravel, cobbles, stones, or boulders (fig. 26). The nature of the till depends on the material over which the ice passed before deposition. The kinds of glacial till in the county are distinguished primarily by soil reaction. Sarona soils are examples of soils that formed dominantly in loamy deposits and in the underlying

loamy or sandy till. Emmet soils formed in loamy, calcareous till.

Glacial outwash is sand, sand and gravel, or stratified sand and gravel deposited by water flowing from a melting glacier. Padus and Pence are examples of soils that formed in loamy and sandy deposits underlain by stratified sand or sand and gravel. Nadeau soils formed in loamy deposits underlain by deposits of very gravelly sandy material. Menahga, Rousseau, and Shawano soils formed in sandy outwash deposits.

Lacustrine deposits are mainly silty, loamy, or clayey but have thin strata of sandy material in some areas. These sediments were deposited in the still water of glacial lakes. Fence soils are examples of soils that formed in silty and loamy deposits underlain by silt or silt stratified with very fine sand. Hibbing soils formed in thin deposits of silty material and in the underlying clayey lacustrine deposits.

Organic material consists mainly of grasses, reeds, sedges, and woody fragments in various stages of decomposition. Dawson and Markey soils formed in organic material 16 to 51 inches deep over mineral deposits. Loxley and Seelyeville soils formed in organic material more than 51 inches thick.

Alluvial deposits on flood plains are of recent origin. The soils that formed in these deposits do not have distinct horizons. Arnheim and Moquah are the only soils in the survey area that formed in these deposits.

Climate

Climate affects soil formation through its effects on the moisture supply in the soil and on soil temperature. It affects the weathering of rocks and the alteration of the parent material through the mechanical action of freezing and thawing and the chemical action generated by the leaching of water.

Climate indirectly affects soil formation through its effects on plant and animal life. Climatic factors influence the rate of plant growth and thus also influence the accumulation of organic matter in the soil and the level of soil fertility.

Marinette County has a cool, subhumid continental climate characteristic of the north-central part of the United States. Climatic differences within the county are too small to have resulted in major differences among the soils.

Plant and Animal Life

Living organisms affect soil formation mainly through the effect of vegetation on the accumulation of organic matter in the soil. Bacteria, fungi, and earthworms also affect soil formation. Plant and animal life add organic matter to the soil and translocate plant nutrients from the lower to the upper layers. Most of the soils in Marinette County formed under forest vegetation, which results in a light colored soil relatively low in content of organic matter. Human activities have an important effect on soil formation because they disturb the natural soil-forming processes. The installation of drainage systems, land clearing, burning, and cultivation have altered the soils in the county. Cultivation has increased the hazard of erosion.

Relief and Drainage

Relief in Marinette County is affected by geologic and hydrographic factors. Hills, valleys, terraces, and outwash plains formed as a result of rain, wind, rivers, glacial meltwater, and glacial deposition. Where dolomite or igneous or metamorphic bedrock is the controlling factor of the topography, the resistance of the underlying rock to weathering has determined the relief. Relief influences soil formation through its effect on the amount of precipitation absorbed by the soil, the rate of erosion, and the movement of materials in suspension or solution from one area to another. The steep soils generally have a thinner solum and a less well developed profile than the more nearly level soils. More water percolates through the less sloping soils. The poorly drained or very poorly drained soils remain cool and wet. These soils have a dark surface layer because of the slow decomposition or accumulation of organic matter.

Drainage characteristics generally are reflected by the color, prominence, and kind of mottles or gleying in the soil horizons. Well drained to excessively drained soils have no mottles. Examples are Emmert, Ishpeming, and Menahga soils. Moderately well drained soils, such as Croswell and Rousseau, have bright colored mottles in the B horizon or the upper part of the C horizon. Banat, Bonduel, Gaastra, Wainola, and other somewhat poorly drained soils have grayish mottles in the B horizon or the BC horizon. Brevort, Bruce, Deford, Ensley, Forada, Nahma, Pickford, Pinconning, and other poorly drained or very poorly drained soils are gleyed in the upper part of the B horizon or in the C horizon directly below the A horizon.

Time

The length of time required for the formation of a given soil depends on the other factors of soil formation. Most of the soils in Marinette County formed in material deposited at about the time of the last

glaciation. The well drained soils that formed in glacial till have well defined horizons as the result of processes that have been active for thousands of years. In contrast, the soils on the flood plains do not have distinct horizons because the soil material has not been in place long enough for the full effect of the soil-forming processes.

Processes of Soil Formation

A combination of basic processes is responsible for horizon differentiation. The main processes are gains, losses, transfers, and transformations. These processes can be active in all soils. Some changes promote horizon differentiation, and others retard it. The nature of the soil at any given point is the net result of all the changes *(13)*.

The interaction among these soil-forming processes is evident in Emmet soils. These soils formed in relatively porous glacial till. Because these soils are rather high on the landscape and are underlain by porous glacial till, they are well drained. The climate favored the growth of trees. Plants and animals contributed to the accumulation of organic matter and organic acids and darkened the surface layer.

As rain water moved downward through these soils, suspended particles of clay were translocated from the surface soil to the subsoil. This clay occurs as clay films on the faces of peds. As a result of this transfer, the soils have more clay in the lower part of the subsoil than in other horizons. Organic acids dissolved weatherable minerals, which then moved downward into the subsoil. This weathering and translocation resulted in the oxidization of iron, which gives the subsoil a redder color than that of the underlying unweathered till. Dissolved carbonates were also translocated downward, so that only free carbonates, as evidenced by effervescence, are in the C horizon.

As a result of the soil-forming processes, the Emmet soils have a very dark gray surface layer, a light colored subsurface layer that has been leached of clay and organic matter, tongues of material from the subsurface layer that extend into the lower part of the subsoil, and clay films and dark reddish brown colors in the lower part of the subsoil. The substratum is unweathered till that has changed little since it was deposited. The processes that were active in the formation of these soils were the accumulation of organic matter in the surface layer, the loss of clay and weatherable minerals from the upper part of the profile and the subsequent transfer to the lower part, and the transformation of iron compounds in the lower part of the subsoil. All of these processes are active in the soils of the county. In some soils certain processes are more active than others. The kinds of parent material and the relief have to a great extent determined the kinds of processes that are dominant in the soils.

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Glossary

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clayey. Clay, silty clay, or sandy clay.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to

pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth, soil. The thickness of the soil over bedrock. In this survey the depth classes are *deep*, more than 40 inches; *moderately deep*, 20 to 40 inches; and *shallow*, 10 to 20 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Droughty (in tables). The soil holds too little water for plants during dry periods.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Flooding (in tables). The soil is flooded by moving water from stream or river overflow or runoff.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or

E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Igneous rock. Rock formed by the solidification of molten material that originated deep within the earth.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loamy. Clay loam, sandy clay loam, loam, very fine sandy loam, fine sandy loam, or sandy loam.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Organic soil. A soil that contains 12 to 18 or more percent organic carbon, depending on the content of mineral materials, and is 16 or more inches thick.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed

depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are—

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandy. Loamy very fine sand, loamy fine sand, loamy sand, loamy coarse sand, very fine sand, fine sand, sand, or coarse sand.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Silty. Silt, silt loam, or silty clay loam.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. The slope classes in this county are—

Nearly level	0 to 2
Gently sloping	2 to 6
Sloping	6 to 12

Moderately steep	12 to 20
Steep	20 to 30
Very steep	more than 30

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tiers. Layers in the control section of organic soils. The organic material is divided into three tiers. The surface tier is the upper 12 inches, the subsurface tier is the next 24 inches, and the bottom tier is the lower 16 inches.

Till plain. An extensive flat to undulating area underlain by glacial till.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1959-81 at Goodman, Wisconsin)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	21.1	1.6	11.4	44	-27	0	1.19	0.44	1.81	4	11.6
February---	26.0	4.4	15.2	49	-24	0	1.02	.37	1.55	3	9.3
March------	36.9	15.5	26.2	64	-15	0	1.85	.49	2.93	4	9.0
April------	51.8	29.2	40.5	82	6	9	2.64	1.63	3.55	7	3.4
May--------	66.0	40.0	53.0	88	19	179	3.60	2.15	4.88	7	.5
June-------	73.8	49.4	61.6	91	31	348	3.85	2.17	5.34	8	.0
July-------	78.3	54.3	66.3	92	37	505	3.32	2.24	4.30	7	.0
August-----	75.6	52.4	64.0	91	35	434	3.74	2.03	5.24	7	.0
September--	65.7	44.5	55.1	85	25	168	3.77	2.22	5.15	7	.0
October----	55.2	35.2	45.2	80	15	69	2.38	1.14	3.44	5	1.0
November---	39.3	23.6	31.5	64	-1	0	1.74	.71	2.60	5	5.3
December---	26.4	9.7	18.1	47	-20	0	1.53	.75	2.20	5	12.0
Yearly:											
Average---	51.3	30.0	40.7	---	---	---	---	---	---	---	---
Extreme---	---	---	---	94	-27	---	---	---	---	---	---
Total-----	---	---	---	---	---	1,712	30.63	26.12	34.81	69	52.1

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1959-81 at Goodman, Wisconsin)

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 16	May 26	June 12
2 years in 10 later than--	May 12	May 21	June 7
5 years in 10 later than--	May 3	May 12	May 29
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 25	Sept. 18	Sept. 8
2 years in 10 earlier than--	Oct. 1	Sept. 23	Sept. 12
5 years in 10 earlier than--	Oct. 12	Oct. 3	Sept. 20

TABLE 3.--GROWING SEASON

(Recorded in the period 1959-81 at Goodman, Wisconsin)

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	140	124	94
8 years in 10	147	131	101
5 years in 10	161	143	113
2 years in 10	175	156	126
1 year in 10	183	163	133

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
AdA	Allendale loamy sand, 0 to 3 percent slopes	2,110	0.2
AkC	Alpena gravelly sandy loam, 6 to 12 percent slopes	930	0.1
AkE	Alpena gravelly sandy loam, 12 to 35 percent slopes	4,330	0.5
Ar	Arnheim silt loam, 0 to 1 percent slopes	16,560	1.8
AuA	Au Gres loamy sand, 0 to 3 percent slopes	26,510	2.9
BaA	Banat sandy loam, 0 to 3 percent slopes	2,150	0.2
BnA	Bonduel loam, 0 to 3 percent slopes	2,090	0.2
Bs	Brevort muck, 0 to 2 percent slopes	3,130	0.3
Bv	Bruce fine sandy loam, 0 to 2 percent slopes	530	0.1
ChA	Charlevoix fine sandy loam, 0 to 3 percent slopes	21,060	2.3
CmB	Charlevoix-Emmet fine sandy loams, 1 to 6 percent slopes	1,920	0.2
CtB	Croswell loamy sand, 1 to 6 percent slopes	18,320	2.0
CuB	Cunard loam, 1 to 6 percent slopes	4,390	0.5
De	Deford mucky fine sand, 0 to 2 percent slopes	20,780	2.3
EaC	Emmert-Pence-Sarona complex, 6 to 15 percent slopes	9,350	1.0
EaD	Emmert-Pence-Sarona complex, 15 to 35 percent slopes	10,845	1.2
EmB	Emmet fine sandy loam, 1 to 6 percent slopes	66,820	7.3
EmC	Emmet fine sandy loam, 6 to 12 percent slopes	22,815	2.5
EmD	Emmet fine sandy loam, 12 to 20 percent slopes	3,670	0.4
EmE	Emmet fine sandy loam, 20 to 30 percent slopes	2,360	0.3
EoB	Emmet cobbly fine sandy loam, 2 to 6 percent slopes	1,390	0.2
EoC	Emmet cobbly fine sandy loam, 6 to 12 percent slopes	1,190	0.1
Ey	Ensley loam, 0 to 2 percent slopes	10,775	1.2
FsB	Fence silt loam, 2 to 6 percent slopes	590	0.1
FsC	Fence silt loam, 6 to 15 percent slopes	200	*
Fw	Forada mucky loam, 0 to 1 percent slopes	1,080	0.1
GaA	Gaastra silt loam, 0 to 3 percent slopes	1,140	0.1
GmB	Goodman silt loam, 2 to 6 percent slopes	3,870	0.4
GmC	Goodman silt loam, 6 to 15 percent slopes	1,350	0.1
HbB	Hibbing silt loam, 1 to 6 percent slopes	665	0.1
IsA	Iosco loamy fine sand, 0 to 3 percent slopes	7,400	0.8
IxC	Ishpeming-Rock outcrop complex, 4 to 15 percent slopes	24,520	2.7
KaB	Karlin loamy fine sand, 2 to 6 percent slopes	3,670	0.4
KaC	Karlin loamy fine sand, 6 to 15 percent slopes	2,275	0.2
KeB	Keweenaw loamy sand, 1 to 6 percent slopes	3,670	0.4
KeC	Keweenaw loamy sand, 6 to 15 percent slopes	8,980	1.0
KeD	Keweenaw loamy sand, 15 to 25 percent slopes	3,330	0.4
Ls	Loxley and Dawson peats, 0 to 1 percent slopes	5,680	0.6
McB	Mancelona loamy sand, 0 to 6 percent slopes	11,420	1.2
McC	Mancelona loamy sand, 6 to 12 percent slopes	4,710	0.5
McD	Mancelona loamy sand, 12 to 20 percent slopes	2,310	0.3
MeB	Manistee loamy sand, 2 to 6 percent slopes	1,320	0.1
MhB	Menahga sand, 0 to 6 percent slopes	79,760	8.7
MhC	Menahga sand, 6 to 15 percent slopes	49,010	5.4
MhD	Menahga sand, 15 to 25 percent slopes	15,365	1.7
MmB	Menahga-Mancelona-Menominee complex, 2 to 6 percent slopes	5,240	0.6
MmC	Menahga-Mancelona-Menominee complex, 6 to 15 percent slopes	20,335	2.2
MmD	Menahga-Mancelona-Menominee complex, 15 to 25 percent slopes	20,635	2.3
MoB	Menominee loamy sand, 2 to 6 percent slopes	14,800	1.6
MoC	Menominee loamy sand, 6 to 12 percent slopes	7,460	0.8
MoD	Menominee loamy sand, 12 to 20 percent slopes	960	0.1
MrC	Michigamme-Rock outcrop complex, 4 to 15 percent slopes	26,090	2.8
MsA	Monico fine sandy loam, 0 to 3 percent slopes	1,235	0.1
Mt	Moquah fine sandy loam, 0 to 2 percent slopes	1,990	0.2
NaB	Nadeau fine sandy loam, 2 to 6 percent slopes	5,680	0.6
NaC	Nadeau fine sandy loam, 6 to 12 percent slopes	4,850	0.5
Nh	Nahma muck, 0 to 2 percent slopes	690	0.1
PaB	Padus fine sandy loam, 1 to 6 percent slopes	12,980	1.4
PaC	Padus fine sandy loam, 6 to 15 percent slopes	6,520	0.7
PaD	Padus fine sandy loam, 15 to 25 percent slopes	2,470	0.3
PkB	Pence sandy loam, 1 to 6 percent slopes	14,160	1.5
PkC	Pence sandy loam, 6 to 15 percent slopes	4,280	0.5
Pm	Pickford mucky silty clay loam, 0 to 2 percent slopes	870	0.1

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
Pn	Pinconning loamy sand, 0 to 2 percent slopes	1,500	0.2
Pt	Pits	625	0.1
Rc	Roscommon mucky loamy sand, 0 to 2 percent slopes	24,700	2.7
Rm	Roscommon-Rock outcrop complex, 0 to 2 percent slopes	7,860	0.9
RsB	Rousseau loamy fine sand, 1 to 6 percent slopes	6,800	0.7
Sa	Saprists and Psammaquents, ponded	2,960	0.3
SbB	Sarona fine sandy loam, 2 to 6 percent slopes	18,770	2.0
SbC	Sarona fine sandy loam, 6 to 15 percent slopes	9,860	1.1
SbD	Sarona fine sandy loam, 15 to 25 percent slopes	2,900	0.3
ScB	Sayner loamy sand, 1 to 6 percent slopes	2,355	0.3
ScC	Sayner loamy sand, 6 to 15 percent slopes	1,360	0.1
Sd	Seelyeville and Markey mucks, 0 to 1 percent slopes	135,801	14.9
SeA	Selkirk silt loam, 0 to 3 percent slopes	1,050	0.1
SfB	Shawano loamy fine sand, 2 to 6 percent slopes	7,310	0.8
SfC	Shawano loamy fine sand, 6 to 12 percent slopes	4,370	0.5
SfD	Shawano loamy fine sand, 12 to 30 percent slopes	895	0.1
SuB	Summerville fine sandy loam, 1 to 6 percent slopes	490	0.1
SuC	Summerville fine sandy loam, 6 to 12 percent slopes	300	*
Ud	Udorthents, loamy, nearly level	660	0.1
Ur	Urban land	180	*
WaA	Wainola loamy fine sand, 0 to 3 percent slopes	22,560	2.5
WrA	Worcester fine sandy loam, 0 to 3 percent slopes	2,120	0.2
	Water	23,040	2.5
	Total	916,051	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
BnA	Bonduel loam, 0 to 3 percent slopes (where drained)
ChA	Charlevoix fine sandy loam, 0 to 3 percent slopes (where drained)
CmB	Charlevoix-Emmet fine sandy loams, 1 to 6 percent slopes (where drained)
EmB	Emmet fine sandy loam, 1 to 6 percent slopes
FsB	Fence silt loam, 2 to 6 percent slopes
GaA	Gaastra silt loam, 0 to 3 percent slopes (where drained)
GmB	Goodman silt loam, 2 to 6 percent slopes
HbB	Hibbing silt loam, 1 to 6 percent slopes
IsA	Iosco loamy fine sand, 0 to 3 percent slopes (where drained)
MsA	Monico fine sandy loam, 0 to 3 percent slopes (where drained)
Mt	Moquah fine sandy loam, 0 to 2 percent slopes
PaB	Padus fine sandy loam, 1 to 6 percent slopes
SbB	Sarona fine sandy loam, 2 to 6 percent slopes
SeA	Selkirk silt loam, 0 to 3 percent slopes (where drained)
WrA	Worcester fine sandy loam, 0 to 3 percent slopes (where drained)

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
AdA------------- Allendale	4W	Slight	Severe	Slight	Moderate	Quaking aspen-------	60	64	White spruce, eastern white pine.
						White ash-----------	---	---	
						Eastern white pine--	---	---	
						White spruce--------	52	100	
						Paper birch---------	---	---	
						Balsam fir----------	62	122	
						Red maple-----------	---	---	
AkC------------- Alpena	3S	Slight	Slight	Moderate	Slight	Sugar maple---------	61	38	Red pine, jack pine.
						Balsam fir----------	---	---	
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
						White spruce--------	---	---	
						Northern whitecedar-	33	48	
						Yellow birch--------	---	---	
AkE------------- Alpena	3R	Moderate	Moderate	Moderate	Slight	Sugar maple---------	61	38	Red pine, jack pine.
						Balsam fir----------	---	---	
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
						White spruce--------	---	---	
						Northern whitecedar-	33	48	
						Yellow birch--------	---	---	
Ar-------------- Arnheim	5W	Slight	Severe	Moderate	Severe	White spruce--------	38	68	White spruce.
						Northern whitecedar-	---	---	
						Red maple-----------	---	---	
						Balsam fir----------	---	---	
						Black spruce--------	---	---	
						Paper birch---------	---	---	
						American elm--------	---	---	
						Quaking aspen-------	---	---	
						Tamarack------------	---	---	
AuA------------- Au Gres	6W	Slight	Severe	Moderate	Severe	Quaking aspen-------	70	81	White spruce, red pine, eastern white pine, Norway spruce.
						Bigtooth aspen------	---	---	
						Balsam fir----------	---	---	
						Paper birch---------	---	---	
						Yellow birch--------	---	---	
						Red maple-----------	---	---	
						Red pine------------	56	90	
						Eastern white pine--	---	---	
						Northern whitecedar-	---	---	
BaA------------- Banat	2W	Slight	Severe	Moderate	Severe	Sugar maple---------	54	34	White spruce, eastern white pine.
						Red maple-----------	---	---	
						Paper birch---------	---	---	
						Eastern white pine--	---	---	
						Northern whitecedar-	---	---	
						White spruce--------	---	---	
						Quaking aspen-------	---	---	
						Black ash-----------	---	---	
BnA------------- Bonduel	4W	Slight	Severe	Slight	Moderate	Northern whitecedar-	35	51	Red maple, white spruce, white ash.
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
						Red maple-----------	---	---	

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
Bs-------------- Brevort	4W	Slight	Severe	Severe	Severe	Green ash-----------	60	51	Red maple, eastern white pine.
						Balsam fir----------	55	107	
						American elm--------	---	---	
						Black ash-----------	---	---	
						Quaking aspen-------	---	---	
						Silver maple--------	---	---	
Bv-------------- Bruce	7W	Slight	Severe	Severe	Severe	White spruce--------	50	96	White spruce, eastern white pine, northern whitecedar.
						Balsam fir----------	---	---	
						Quaking aspen-------	---	---	
						Yellow birch--------	---	---	
						Northern whitecedar-	---	---	
						Red maple-----------	---	---	
						Black ash-----------	---	---	
ChA------------- Charlevoix	3W	Slight	Severe	Slight	Moderate	Red maple-----------	65	40	White spruce, eastern white pine, Norway spruce.
						Paper birch---------	---	---	
						Balsam fir----------	---	---	
						White spruce--------	55	107	
						Northern whitecedar-	---	---	
						Eastern hemlock-----	---	---	
						Quaking aspen-------	---	---	
						Black ash-----------	---	---	
CmB**:									
Charlevoix-----	3W	Slight	Severe	Slight	Moderate	Red maple-----------	65	40	White spruce, eastern white pine, Norway spruce.
						Paper birch---------	---	---	
						Balsam fir----------	---	---	
						White spruce--------	55	107	
						Northern whitecedar-	---	---	
						Eastern hemlock-----	---	---	
						Quaking aspen-------	---	---	
						Black ash-----------	---	---	
Emmet----------	3L	Slight	Moderate	Slight	Slight	Sugar maple---------	66	41	White spruce, red pine, eastern white pine.
						Quaking aspen-------	---	---	
						Yellow birch--------	---	---	
						Red pine------------	---	---	
						American basswood---	65	59	
						American beech------	---	---	
						Eastern white pine--	---	---	
						Northern red oak----	74	72	
						Eastern hemlock-----	---	---	
						White ash-----------	67	61	
CtB------------- Croswell	5S	Slight	Slight	Moderate	Moderate	Quaking aspen-------	68	78	Red pine, eastern white pine, white spruce.
						Red pine------------	55	88	
						Jack pine-----------	53	73	
						Northern red oak----	---	---	
						Black cherry--------	---	---	
						Eastern white pine--	---	---	
						Bigtooth aspen------	---	---	
						Red maple-----------	---	---	
CuB------------- Cunard	3D	Slight	Moderate	Slight	Moderate	Sugar maple---------	60	38	Red pine, white spruce, eastern white pine.
						American basswood---	---	---	
						American beech------	---	---	
						White ash-----------	---	---	
						Northern red oak----	---	---	
						Bigtooth aspen------	---	---	

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
De-------------- Deford	4W	Slight	Severe	Severe	Severe	Quaking aspen-------	60	64	Eastern white pine, white spruce.
						Balsam fir----------	---	---	
						Northern whitecedar-	---	---	
						American basswood---	---	---	
						Red maple-----------	---	---	
						Green ash-----------	71	67	
EaC**:									
Emmert---------	6S	Slight	Slight	Severe	Slight	Red pine------------	52	80	Red pine, jack pine, eastern white pine.
						Eastern white pine--	50	90	
						Jack pine-----------	60	85	
						White spruce--------	55	107	
Pence----------	3A	Slight	Slight	Slight	Slight	Sugar maple---------	59	37	Red pine, eastern white pine, jack pine.
						Red pine------------	59	99	
						Eastern white pine--	57	112	
						American basswood---	---	---	
						Balsam fir----------	---	---	
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
						Yellow birch--------	---	---	
Sarona---------	3L	Slight	Moderate	Slight	Slight	Sugar maple---------	64	40	Red pine, eastern white pine, white spruce.
						Northern red oak----	72	69	
						American basswood---	70	66	
						Quaking aspen-------	---	---	
						White ash-----------	75	73	
EaD**:									
Emmert---------	6R	Moderate	Moderate	Severe	Slight	Red pine------------	52	80	Red pine, jack pine, eastern white pine.
						Eastern white pine--	50	90	
						Jack pine-----------	60	85	
						White spruce--------	55	107	
Pence----------	3R	Moderate	Moderate	Slight	Slight	Sugar maple---------	59	37	Red pine, eastern white pine, jack pine.
						Red pine------------	59	99	
						Eastern white pine--	57	112	
						American basswood---	---	---	
						Balsam fir----------	---	---	
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
						Yellow birch--------	---	---	
Sarona---------	3R	Moderate	Moderate	Slight	Slight	Sugar maple---------	64	40	Red pine, eastern white pine, white spruce.
						Northern red oak----	72	69	
						American basswood---	70	66	
						Quaking aspen-------	---	---	
						White ash-----------	75	73	
EmB, EmC-------- Emmet	3L	Slight	Moderate	Slight	Slight	Sugar maple---------	66	41	White spruce, red pine, eastern white pine.
						Quaking aspen-------	---	---	
						Yellow birch--------	---	---	
						Red pine------------	---	---	
						American basswood---	65	59	
						American beech------	---	---	
						Eastern white pine--	---	---	
						Northern red oak----	74	72	
						Eastern hemlock-----	---	---	
						White ash-----------	67	61	

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
EmD, EmE-------- Emmet	3R	Moderate	Moderate	Slight	Slight	Sugar maple---------	66	41	White spruce, red pine, eastern white pine.
						Quaking aspen-------	---	---	
						Yellow birch--------	---	---	
						Red pine------------	---	---	
						American basswood---	65	59	
						American beech------	---	---	
						Eastern white pine--	---	---	
						Northern red oak----	74	72	
						Eastern hemlock-----	---	---	
						White ash-----------	67	61	
EoB, EoC-------- Emmet	3L	Slight	Moderate	Slight	Slight	Sugar maple---------	66	41	White spruce, red pine, eastern white pine.
						Quaking aspen-------	---	---	
						Yellow birch--------	---	---	
						Red pine------------	---	---	
						American basswood---	---	---	
						American beech------	---	---	
						Eastern white pine--	---	---	
						Northern red oak----	74	72	
						Eastern hemlock-----	---	---	
Ey-------------- Ensley	3W	Slight	Severe	Severe	Severe	Red maple-----------	62	39	White spruce.
						Balsam fir----------	60	118	
						White spruce--------	---	---	
						Green ash-----------	---	---	
						Yellow birch--------	---	---	
						Black ash-----------	---	---	
FsB, FsC-------- Fence	3L	Slight	Severe	Slight	Slight	Sugar maple---------	65	40	Red pine, eastern white pine, white spruce.
						Yellow birch--------	65	40	
						American basswood---	68	63	
						Quaking aspen-------	---	---	
						Bigtooth aspen------	---	---	
Fw-------------- Forada	3W	Slight	Severe	Severe	Severe	Red maple-----------	62	39	White spruce.
						Balsam fir----------	60	118	
						Black ash-----------	48	24	
						White spruce--------	---	---	
						Northern whitecedar-	---	---	
GaA------------- Gaastra	3W	Slight	Severe	Slight	Moderate	Sugar maple---------	61	38	White spruce, eastern white pine.
						Red maple-----------	---	---	
						Quaking aspen-------	---	---	
						Black ash-----------	---	---	
						White spruce--------	52	100	
						Balsam fir----------	---	---	
						American basswood---	---	---	
GmB, GmC-------- Goodman	3L	Slight	Moderate	Slight	Slight	Sugar maple---------	69	42	Eastern white pine, red pine, white spruce.
						Yellow birch--------	---	---	
						American basswood---	68	63	
						Bigtooth aspen------	---	---	
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
						Northern red oak----	67	61	

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
HbB------------- Hibbing	6L	Slight	Moderate	Slight	Slight	Quaking aspen------- Red pine------------ Eastern white pine-- White spruce-------- Balsam fir---------- Paper birch---------	76 59 46 50 51 55	89 99 78 96 98 57	Red pine, black spruce, white spruce, oak.
IsA------------- Iosco	4W	Slight	Severe	Slight	Moderate	Northern red oak---- Sugar maple--------- Red pine------------ Yellow birch-------- White ash----------- Quaking aspen-------	65 --- --- --- --- ---	59 --- --- --- --- ---	Red pine, eastern white pine, white spruce.
IxC**:									
Ishpeming------	5A	Slight	Slight	Slight	Slight	Quaking aspen------- Balsam fir---------- Red maple----------- Eastern hemlock----- Paper birch--------- Bigtooth aspen------ Sugar maple--------- Yellow birch-------- American basswood---	63 --- --- --- 60 68 --- --- ---	70 --- --- --- 65 78 --- --- ---	Red pine, jack pine.
Rock outcrop.									
KaB, KaC-------- Karlin	3A	Slight	Slight	Slight	Slight	Sugar maple--------- Yellow birch-------- Bigtooth aspen------ Northern red oak---- American basswood--- Red pine------------ Eastern white pine--	61 --- --- 59 --- 56 57	38 --- --- 49 --- 90 112	Red pine, eastern white pine.
KeB, KeC-------- Keweenaw	3A	Slight	Slight	Slight	Slight	Sugar maple--------- Eastern hemlock----- Yellow birch-------- Northern red oak---- Paper birch--------- Red maple----------- Black cherry-------- Eastern white pine-- Balsam fir---------- Quaking aspen-------	61 --- --- 67 --- --- --- --- --- ---	38 --- --- 61 --- --- --- --- --- ---	Red pine, eastern white pine.
KeD------------- Keweenaw	3R	Moderate	Moderate	Slight	Slight	Sugar maple--------- Eastern hemlock----- Yellow birch-------- Northern red oak---- Paper birch--------- Red maple----------- Black cherry-------- Eastern white pine-- Balsam fir---------- Quaking aspen-------	61 --- --- 67 --- --- --- --- --- ---	38 --- --- 61 --- --- --- --- --- ---	Red pine, eastern white pine.

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
McB, McC: Mancelona	3A	Slight	Slight	Slight	Slight	Northern pin oak	57	40	Red pine, eastern white pine.
						Sugar maple	58	37	
						Northern red oak	59	49	
						Red pine	---	---	
						Jack pine	---	---	
						Eastern white pine	---	---	
						Yellow birch	---	---	
McD: Mancelona	3R	Moderate	Moderate	Slight	Slight	Northern pin oak	57	40	Red pine, eastern white pine.
						Sugar maple	58	37	
						Northern red oak	59	49	
						Red pine	---	---	
						Jack pine	---	---	
						Eastern white pine	---	---	
						Yellow birch	---	---	
MeB: Manistee	3A	Slight	Slight	Slight	Slight	Sugar maple	61	38	Red pine, eastern white pine.
						Eastern white pine	---	---	
						Red maple	---	---	
						Red pine	---	---	
						American basswood	---	---	
						Eastern hemlock	---	---	
						Northern red oak	55	42	
						White ash	---	---	
MhB, MhC: Menahga	6S	Slight	Moderate	Moderate	Slight	Jack pine	59	84	Red pine, white spruce, eastern white pine, jack pine.
						Red pine	60	101	
						Eastern white pine	55	106	
						Quaking aspen	65	73	
						Paper birch	60	65	
						Northern pin oak	55	38	
MhD: Menahga	6R	Moderate	Moderate	Moderate	Slight	Jack pine	59	84	Red pine, white spruce, eastern white pine, jack pine.
						Red pine	60	101	
						Eastern white pine	55	106	
						Quaking aspen	65	73	
						Paper birch	60	65	
						Northern pin oak	55	38	
MmB**, MmC**:									
Menahga	6S	Slight	Moderate	Moderate	Slight	Jack pine	59	84	Red pine, white spruce, eastern white pine, jack pine.
						Red pine	60	101	
						Eastern white pine	55	106	
						Quaking aspen	65	73	
						Paper birch	60	65	
						Northern pin oak	55	38	
Mancelona	3A	Slight	Slight	Slight	Slight	Northern pin oak	57	40	Red pine, eastern white pine.
						Sugar maple	58	37	
						Northern red oak	59	49	
						Red pine	---	---	
						Jack pine	---	---	
						Eastern white pine	---	---	
						Yellow birch	---	---	
Menominee	5S	Slight	Moderate	Moderate	Slight	Northern red oak	71	67	Red pine, eastern white pine, white spruce.
						Sugar maple	64	40	
						American basswood	---	---	
						Red maple	---	---	
						Quaking aspen	74	86	

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
MmD**:									
Menahga--------	6R	Moderate	Moderate	Moderate	Slight	Jack pine-----------	59	84	Red pine, white spruce, eastern white pine, jack pine.
						Red pine------------	60	101	
						Eastern white pine--	55	106	
						Quaking aspen-------	65	73	
						Paper birch---------	60	65	
						Northern pin oak----	55	38	
Mancelona------	3R	Moderate	Moderate	Slight	Slight	Northern pin oak----	57	40	Red pine, eastern white pine.
						Sugar maple---------	58	37	
						Northern red oak----	59	49	
						Red pine------------	---	---	
						Jack pine-----------	---	---	
						Eastern white pine--	---	---	
						Yellow birch--------	---	---	
Menominee------	5R	Moderate	Moderate	Moderate	Slight	Northern red oak----	71	67	Red pine, eastern white pine, white spruce.
						Sugar maple---------	64	40	
						American basswood---	---	---	
						Red maple-----------	---	---	
						Quaking aspen-------	74	86	
MoB, MoC-------- Menominee	5S	Slight	Moderate	Moderate	Slight	Northern red oak----	71	67	Red pine, eastern white pine, white spruce.
						Sugar maple---------	64	40	
						American basswood---	---	---	
						Red maple-----------	---	---	
						Quaking aspen-------	74	86	
MoD------------- Menominee	5R	Moderate	Moderate	Moderate	Slight	Northern red oak----	71	67	Red pine, eastern white pine, white spruce.
						Sugar maple---------	64	40	
						American basswood---	---	---	
						Red maple-----------	---	---	
						Quaking aspen-------	74	86	
MrC**:									
Michigamme-----	3L	Slight	Moderate	Slight	Slight	Sugar maple---------	60	38	White spruce, eastern white pine.
						Red maple-----------	---	---	
						Yellow birch--------	60	38	
						Balsam fir----------	---	---	
						Bigtooth aspen------	---	---	
						Eastern hemlock-----	---	---	
						White spruce--------	---	---	
						Black cherry--------	---	---	
						Northern red oak----	57	46	
Rock outcrop.									
MsA------------- Monico	3W	Slight	Moderate	Slight	Moderate	Sugar maple---------	63	39	White spruce, black spruce, eastern white pine, red maple, white ash.
						American basswood---	---	---	
						Yellow birch--------	---	---	
						Red maple-----------	---	---	
						White ash-----------	---	---	
Mt-------------- Moquah	3L	Slight	Moderate	Slight	Slight	Red maple-----------	60	38	Eastern white pine, red pine, white spruce, black spruce.
						Northern red oak----	---	---	
						American basswood---	---	---	
						White ash-----------	---	---	
						White spruce--------	---	---	
						Eastern white pine--	---	---	

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
NaB, NaC: Nadeau	2L	Slight	Moderate	Slight	Slight	Sugar maple	55	35	Red pine, eastern white pine.
						Quaking aspen	---	---	
						Bigtooth aspen	63	70	
						Northern red oak	65	59	
						Eastern white pine	---	---	
						White ash	---	---	
Nh: Nahma	4W	Slight	Severe	Severe	Severe	Balsam fir	35	60	Black spruce.
						Quaking aspen	---	---	
						Paper birch	---	---	
						Northern whitecedar	---	---	
						Black ash	---	---	
						Red maple	---	---	
						Yellow birch	---	---	
						Green ash	66	60	
PaB, PaC: Padus	3L	Slight	Moderate	Slight	Slight	Sugar maple	67	41	Red pine, eastern white pine, white spruce.
						Northern red oak	70	66	
						Bigtooth aspen	78	91	
						White ash	---	---	
						American basswood	---	---	
						Red pine	---	---	
PaD: Padus	3R	Moderate	Moderate	Slight	Slight	Sugar maple	67	41	Red pine, eastern white pine, white spruce.
						Northern red oak	70	66	
						Bigtooth aspen	78	91	
						White ash	---	---	
						American basswood	---	---	
						Red pine	---	---	
PkB, PkC: Pence	3A	Slight	Slight	Slight	Slight	Sugar maple	59	37	Red pine, eastern white pine, jack pine.
						Red pine	59	99	
						Eastern white pine	57	112	
						American basswood	---	---	
						Balsam fir	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Yellow birch	---	---	
Pm: Pickford	6W	Slight	Severe	Severe	Severe	White spruce	45	84	White spruce, eastern white pine.
						Balsam fir	45	83	
						Paper birch	---	---	
						Eastern hemlock	---	---	
						Quaking aspen	---	---	
						Northern whitecedar	---	---	
Pn: Pinconning	3W	Slight	Severe	Severe	Severe	Quaking aspen	50	43	Black spruce.
						Black ash	---	---	
						Black spruce	---	---	
						Northern whitecedar	---	---	
Rc: Roscommon	6W	Slight	Severe	Severe	Severe	Quaking aspen	74	86	Black spruce.
						Black spruce	---	---	
						Northern whitecedar	---	---	
						Jack pine	---	---	
						Balsam fir	56	109	
						Red maple	---	---	
						Yellow birch	---	---	

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
Rm**:									
Roscommon	6W	Slight	Severe	Severe	Severe	Quaking aspen	74	86	Black spruce.
						Black spruce	---	---	
						Northern whitecedar	---	---	
						Jack pine	---	---	
						Balsam fir	56	109	
						Red maple	---	---	
						Yellow birch	---	---	
Rock outcrop.									
RsB Rousseau	5S	Slight	Moderate	Moderate	Slight	Quaking aspen	65	73	Red pine, jack pine.
						Sugar maple	60	38	
						Red maple	---	---	
						Balsam fir	---	---	
						Northern red oak	70	66	
						Eastern hemlock	---	---	
						Red pine	---	---	
						Jack pine	62	89	
						Paper birch	65	73	
						Yellow birch	---	---	
						Bigtooth aspen	---	---	
SbB, SbC Sarona	3L	Slight	Moderate	Slight	Slight	Sugar maple	64	40	Red pine, eastern white pine, white spruce.
						Northern red oak	72	69	
						American basswood	70	66	
						Quaking aspen	---	---	
						White ash	75	73	
SbD Sarona	3R	Moderate	Moderate	Slight	Slight	Sugar maple	64	40	Red pine, eastern white pine, white spruce.
						Northern red oak	72	69	
						American basswood	70	66	
						Quaking aspen	---	---	
						White ash	75	73	
ScB, ScC Sayner	7A	Slight	Slight	Slight	Slight	Red pine	59	99	Red pine, eastern white pine, jack pine.
						Jack pine	---	---	
						Eastern white pine	57	112	
						Northern red oak	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Red maple	---	---	
Sd**:									
Seelyeville	6W	Slight	Severe	Severe	Severe	Balsam fir	45	83	
						Black spruce	34	45	
						Tamarack	56	52	
						Black ash	---	---	
						Northern whitecedar	30	42	
Markey	6W	Slight	Severe	Severe	Severe	Balsam fir	49	93	
						Northern whitecedar	41	61	
						Tamarack	---	---	
						White spruce	---	---	
SeA Selkirk	6C	Slight	Severe	Moderate	Severe	Quaking aspen	71	82	White spruce, eastern white pine, northern whitecedar.
						Sugar maple	45	30	
						White spruce	45	84	
						Red maple	---	---	
						Eastern hemlock	---	---	
						Balsam fir	45	83	

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
SfB, SfC: Shawano	4S	Slight	Moderate	Moderate	Slight	Northern red oak	62	54	Red pine, eastern white pine, jack pine.
						Red pine	---	---	
						Eastern white pine	---	---	
						Jack pine	---	---	
						Paper birch	---	---	
						Northern pin oak	64	47	
SfD: Shawano	4R	Moderate	Moderate	Moderate	Slight	Northern red oak	62	54	Red pine, eastern white pine, jack pine.
						Red pine	---	---	
						Eastern white pine	---	---	
						Jack pine	---	---	
						Paper birch	---	---	
						Northern pin oak	64	47	
SuB, SuC: Summerville	3D	Slight	Moderate	Moderate	Severe	Sugar maple	61	38	Northern whitecedar, white spruce, eastern white pine.
						Paper birch	53	53	
						American beech	---	---	
						Quaking aspen	---	---	
						Northern whitecedar	---	---	
						Balsam fir	---	---	
						Red pine	---	---	
						Eastern white pine	---	---	
WaA: Wainola	6W	Slight	Severe	Moderate	Severe	Quaking aspen	70	81	White spruce, Norway spruce, eastern white pine.
						Green ash	68	63	
						Red maple	68	42	
						Northern red oak	68	63	
WrA: Worcester	2W	Slight	Severe	Slight	Moderate	Red maple	55	35	Eastern white pine, red maple, white spruce.
						Sugar maple	---	---	
						Yellow birch	---	---	
						Balsam fir	---	---	
						White spruce	---	---	

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND EQUIPMENT USE

(Only the soils suitable for the production of commercial trees are listed)

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)
	Logging areas and skid trails	Log landings	Haul roads	
AdA: Allendale	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Summer, fall, winter.
AkC: Alpena	Slight	Moderate: slope.	Slight	Year round.
AkE: Alpena	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
Ar: Arnheim	Severe: wetness, low strength.	Severe: wetness, flooding, low strength.	Severe: wetness, flooding, low strength.	Summer, winter.
AuA: Au Gres	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.
BaA: Banat	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall, winter.
BnA: Bonduel	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall, winter.
Bs: Brevort	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness.	Winter.
Bv: Bruce	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter.
ChA: Charlevoix	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.
CmB*:				
Charlevoix	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.
Emmet	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.
CtB: Croswell	Slight	Slight	Slight	Year round.
CuB: Cunard	Moderate: low strength.	Moderate: depth to rock, low strength.	Moderate: depth to rock, low strength.	Summer, fall, winter.
De: Deford	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter.

See footnote at end of table.

TABLE 7.--WOODLAND EQUIPMENT USE--Continued

Soil name and map symbol	Ratings for most limiting season(s): Logging areas and skid trails	Log landings	Haul roads	Preferred operating season(s)
EaC*:				
Emmert	Slight	Moderate: slope.	Slight	Year round.
Pence	Slight	Moderate: slope.	Slight	Year round.
Sarona	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.
EaD*:				
Emmert	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
Pence	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
Sarona	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, low strength.	Summer, fall, winter.
EmB Emmet	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.
EmC Emmet	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.
EmD Emmet	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, low strength.	Summer, fall, winter.
EmE Emmet	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, low strength.	Summer, fall, winter.
EoB Emmet	Moderate: low strength.	Moderate: too cobbly, low strength.	Moderate: too cobbly, low strength.	Summer, fall, winter.
EoC Emmet	Moderate: low strength.	Moderate: slope, too cobbly, low strength.	Moderate: too cobbly, low strength.	Summer, fall, winter.
Ey Ensley	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter.
FsB Fence	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall, winter.
FsC Fence	Severe: low strength.	Severe: slope, low strength.	Severe: low strength.	Summer, fall, winter.

See footnote at end of table.

TABLE 7.--WOODLAND EQUIPMENT USE--Continued

Soil name and map symbol	Ratings for most limiting season(s): Logging areas and skid trails	Log landings	Haul roads	Preferred operating season(s)
Fw: Forada	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter.
GaA: Gaastra	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.
GmB: Goodman	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.
GmC: Goodman	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.
HbB: Hibbing	Moderate: low strength.	Moderate: too clayey, low strength.	Severe: too clayey.	Summer, winter.
IsA: Iosco	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall, winter.
IxC*:				
Ishpeming	Severe: rock outcrop.	Severe: rock outcrop.	Severe: rock outcrop.	Year round.
Rock outcrop.				
KaB: Karlin	Slight	Slight	Slight	Year round.
KaC: Karlin	Slight	Moderate: slope.	Slight	Year round.
KeB: Keweenaw	Slight	Slight	Slight	Year round.
KeC: Keweenaw	Slight	Moderate: slope.	Slight	Year round.
KeD: Keweenaw	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
McB: Mancelona	Slight	Slight	Slight	Year round.
McC: Mancelona	Slight	Moderate: slope.	Slight	Year round.
McD: Mancelona	Moderate: slope.	Severe: slope.	Severe: slope.	Year round.
MeB: Manistee	Slight	Slight	Slight	Year round.

See footnote at end of table.

TABLE 7.--WOODLAND EQUIPMENT USE--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)
	Logging areas and skid trails	Log landings	Haul roads	
MhB--------------- Menahga	Slight---------	Slight---------	Slight---------	Year round.
MhC--------------- Menahga	Slight---------	Moderate: slope.	Slight---------	Year round.
MhD--------------- Menahga	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
MmB*:				
Menahga----------	Slight---------	Slight---------	Slight---------	Year round.
Mancelona--------	Slight---------	Slight---------	Slight---------	Year round.
Menominee--------	Slight---------	Slight---------	Slight---------	Year round.
MmC*:				
Menahga----------	Slight---------	Moderate: slope.	Slight---------	Year round.
Mancelona--------	Slight---------	Moderate: slope.	Slight---------	Year round.
Menominee--------	Slight---------	Moderate: slope.	Slight---------	Year round.
MmD*:				
Menahga----------	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
Mancelona--------	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
Menominee--------	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
MoB--------------- Menominee	Slight---------	Slight---------	Slight---------	Year round.
MoC--------------- Menominee	Slight---------	Moderate: slope.	Slight---------	Year round.
MoD--------------- Menominee	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
MrC*:				
Michigamme-------	Severe: rock outcrop.	Severe: rock outcrop.	Severe: rock outcrop.	Year round.
Rock outcrop.				
MsA--------------- Monico	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.

See footnote at end of table.

TABLE 7.--WOODLAND EQUIPMENT USE--Continued

Soil name and map symbol	Ratings for most limiting season(s): Logging areas and skid trails	Log landings	Haul roads	Preferred operating season(s)
Mt: Moquah	Moderate: low strength, flooding.	Severe: flooding.	Severe: flooding.	Summer, fall, winter.
NaB: Nadeau	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Year round.
NaC: Nadeau	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Year round.
Nh: Nahma	Severe: wetness, low strength.	Severe: wetness, depth to rock, low strength.	Severe: wetness, low strength.	Winter.
PaB: Padus	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Year round.
PaC: Padus	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Year round.
PaD: Padus	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, low strength.	Year round.
PkB: Pence	Slight	Slight	Slight	Year round.
PkC: Pence	Slight	Moderate: slope.	Slight	Year round.
Pm: Pickford	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter.
Pn: Pinconning	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter.
Rc: Roscommon	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter.
Rm*:				
Roscommon	Severe: wetness, rock outcrop.	Severe: wetness, rock outcrop.	Severe: wetness, rock outcrop.	Winter.
Rock outcrop.				
RsB: Rousseau	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Year round.
SbB: Sarona	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Year round.

See footnote at end of table.

TABLE 7.--WOODLAND EQUIPMENT USE--Continued

Soil name and map symbol	Ratings for most limiting season(s): Logging areas and skid trails	Log landings	Haul roads	Preferred operating season(s)
SbC: Sarona	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Year round.
SbD: Sarona	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, low strength.	Year round.
ScB: Sayner	Slight	Slight	Slight	Year round.
ScC: Sayner	Slight	Moderate: slope.	Slight	Year round.
Sd*:				
Seelyeville	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness.	Winter.
Markey	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter.
SeA: Selkirk	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.
SfB: Shawano	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Year round.
SfC: Shawano	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Year round.
SfD: Shawano	Moderate: slope, too sandy.	Severe: slope.	Moderate: slope, too sandy.	Year round.
SuB: Summerville	Moderate: low strength.	Severe: depth to rock.	Severe: depth to rock.	Year round.
SuC: Summerville	Moderate: low strength.	Severe: depth to rock.	Severe: depth to rock.	Year round.
WaA: Wainola	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Summer, fall, winter.
WrA: Worcester	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Bromegrass-alfalfa hay	Timothy-red clover hay	Kentucky bluegrass
		Bu	Tons	Bu	Tons	Tons	AUM*
AdA-------------- Allendale	IIIw	70	11	65	---	2.5	---
AkC-------------- Alpena	VIs	---	---	---	---	---	---
AkE-------------- Alpena	VIIs	---	---	---	---	---	---
Ar--------------- Arnheim	Vw	---	---	---	---	---	---
AuA-------------- Au Gres	IVw	55	10	45	---	1.8	1.5
BaA-------------- Banat	IIIw	70	11	65	---	3.0	3.5
BnA-------------- Bonduel	IIw	80	12	75	---	3.5	3.7
Bs--------------- Brevort	Vw	---	---	---	---	---	---
Bv--------------- Bruce	Vw	---	---	---	---	---	---
ChA-------------- Charlevoix	IIw	85	15	80	---	3.5	4.0
CmB-------------- Charlevoix-Emmet	IIw	80	15	75	3.1	3.1	4.0
CtB-------------- Croswell	IVs	50	9	40	---	2.5	2.3
CuB-------------- Cunard	IIe	80	14	55	4.0	---	3.0
De--------------- Deford	Vw	---	---	---	---	---	---
EaC-------------- Emmert-Pence-Sarona	IVs	49	8	37	2.6	---	1.5
EaD-------------- Emmert-Pence-Sarona	VIIs	---	---	---	---	---	---
EmB-------------- Emmet	IIe	90	16	75	4.8	3.8	4.0
EmC-------------- Emmet	IIIe	90	16	60	4.8	---	4.0

See footnotes at end of table.

TABLE 8.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Bromegrass-alfalfa hay	Timothy-red clover hay	Kentucky bluegrass
		Bu	Tons	Bu	Tons	Tons	AUM*
EmD-------------- Emmet	IVe	70	12	50	2.3	---	3.5
EmE-------------- Emmet	VIe	---	---	---	---	---	3.0
EoB, EoC-------- Emmet	VIs	---	---	---	---	---	3.8
Ey--------------- Ensley	Vw	---	---	---	---	---	---
FsB-------------- Fence	IIe	80	13	75	4.5	3.5	3.3
FsC-------------- Fence	IIIe	80	12	70	4.0	---	2.8
Fw--------------- Forada	VIw	---	---	---	---	---	---
GaA-------------- Gaastra	IIw	80	13	85	---	3.0	---
GmB-------------- Goodman	IIe	80	13	75	4.5	---	3.7
GmC-------------- Goodman	IIIe	80	12	70	4.3	---	3.2
HbB-------------- Hibbing	IIe	75	14	80	4.9	---	---
IsA-------------- Iosco	IIIw	80	13	65	---	3.5	4.0
IxC**------------ Ishpeming-Rock outcrop	VIIs	---	---	---	---	---	---
KaB-------------- Karlin	IIIs	70	13	60	3.0	---	3.3
KaC-------------- Karlin	IIIe	65	12	55	2.8	---	2.8
KeB-------------- Keweenaw	IIIe	70	13	60	2.1	---	3.3
KeC-------------- Keweenaw	IVe	---	---	50	2.0	---	2.8
KeD-------------- Keweenaw	VIe	---	---	---	---	---	---
Ls--------------- Loxley and Dawson	VIIw	---	---	---	---	---	---
McB-------------- Mancelona	IIIs	65	12	60	3.0	---	2.5

See footnotes at end of table.

TABLE 8.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Bromegrass-alfalfa hay	Timothy-red clover hay	Kentucky bluegrass
		Bu	Tons	Bu	Tons	Tons	AUM*
McC-------------- Mancelona	IIIe	60	11	55	2.6	---	2.0
McD-------------- Mancelona	IVe	---	---	45	2.2	---	1.5
MeB-------------- Manistee	IIIs	75	12	70	3.5	---	---
MhB-------------- Menahga	IVs	45	6	45	2.3	---	1.2
MhC-------------- Menahga	VIs	---	---	---	---	---	1.0
MhD-------------- Menahga	VIIs	---	---	---	---	---	0.7
MmB-------------- Menahga-Mancelona-Menominee	IVs	70	11	55	3.1	---	2.5
MmC-------------- Menahga-Mancelona-Menominee	VIs	---	---	50	2.8	---	2.0
MmD-------------- Menahga-Mancelona-Menominee	VIIs	---	---	---	---	---	---
MoB-------------- Menominee	IIIe	85	14	65	4.0	---	3.0
MoC-------------- Menominee	IVe	80	13	55	3.7	---	2.7
MoD-------------- Menominee	VIe	---	---	---	3.2	---	2.3
MrC**------------ Michigamme-Rock outcrop	VIIs	---	---	---	---	---	---
MsA-------------- Monico	IIw	80	12	70	---	3.5	3.3
Mt--------------- Moquah	IIIw	65	11	60	---	3.0	3.6
NaB-------------- Nadeau	IIIs	75	12	65	2.2	---	2.8
NaC-------------- Nadeau	IVe	70	11	60	2.0	---	2.4
Nh--------------- Nahma	Vw	---	---	---	---	---	---

See footnotes at end of table.

TABLE 8.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Bromegrass-alfalfa hay	Timothy-red clover hay	Kentucky bluegrass
		Bu	Tons	Bu	Tons	Tons	AUM*
PaB------------- Padus	IIe	80	13	75	4.0	---	2.6
PaC------------- Padus	IIIe	75	12	70	3.5	---	2.2
PaD------------- Padus	VIe	---	---	---	2.5	---	1.2
PkB------------- Pence	IIIe	65	11	60	3.5	---	1.8
PkC------------- Pence	IVe	60	10	50	3.0	---	1.3
Pm-------------- Pickford	Vw	---	---	---	---	---	---
Pn-------------- Pinconning	Vw	---	---	---	---	---	---
Pt**. Pits							
Rc-------------- Roscommon	VIw	---	---	---	---	---	---
Rm**------------ Roscommon-Rock outcrop	VIIs	---	---	---	---	---	---
RsB------------- Rousseau	IIIs	60	10	50	2.5	---	1.8
Sa-------------- Saprists and Psammaquents	VIIIw	---	---	---	---	---	---
SbB------------- Sarona	IIe	80	13	65	3.5	2.5	3.0
SbC------------- Sarona	IIIe	75	12	60	3.0	---	2.5
SbD------------- Sarona	VIe	---	---	---	2.0	---	1.5
ScB------------- Sayner	IVs	40	7	35	2.0	---	1.0
ScC------------- Sayner	VIs	---	---	---	1.5	---	0.6
Sd-------------- Seelyeville and Markey	VIw	---	---	---	---	---	---
SeA------------- Selkirk	IIIw	80	14	75	---	---	---
SfB------------- Shawano	IVs	55	9	55	3.0	---	1.5

See footnotes at end of table.

TABLE 8.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Bromegrass-alfalfa hay	Timothy-red clover hay	Kentucky bluegrass
		Bu	Tons	Bu	Tons	Tons	AUM*
SfC------------- Shawano	VIs	---	---	30	2.5	---	1.0
SfD------------- Shawano	VIIs	---	---	---	---	---	0.3
SuB------------- Summerville	IIIs	---	---	30	2.1	---	2.8
SuC------------- Summerville	IVe	---	---	---	1.8	---	2.4
Ud. Udorthents							
Ur**. Urban land							
WaA------------- Wainola	IIIw	75	14	65	---	3.0	2.1
WrA------------- Worcester	IIw	65	11	75	---	3.0	2.6

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
AdA: Allendale	---	American cranberrybush, silky dogwood, Amur privet, lilac, nannyberry viburnum, Roselow sargent crabapple, northern whitecedar.	White spruce, Manchurian crabapple, Norway spruce.	Eastern white pine, red maple.	---
AkC, AkE. Alpena					
Ar. Arnheim					
AuA: Au Gres	---	Silky dogwood, American cranberrybush, Amur maple, common ninebark, nannyberry viburnum.	White spruce, Manchurian crabapple, Norway spruce.	Jack pine, green ash, eastern white pine.	Imperial Carolina poplar.
BaA: Banat	---	Amur maple, common ninebark, lilac, Siberian peashrub, Roselow sargent crabapple.	Siberian crabapple, white spruce, Norway spruce.	Eastern white pine, red pine, jack pine, green ash.	---
BnA: Bonduel	---	Common ninebark, redosier dogwood, nannyberry, viburnum, lilac, American cranberrybush, silky dogwood, northern whitecedar.	White spruce	Eastern white pine, white ash, silver maple, red maple.	---
Bs. Brevort					
Bv. Bruce					
ChA: Charlevoix	---	American cranberrybush, silky dogwood, nannyberry viburnum, Amur privet, common ninebark, northern whitecedar.	White spruce, Manchurian crabapple, Norway spruce.	Red maple, eastern white pine, green ash.	---

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
CmB*:					
Charlevoix	---	American cranberrybush, silky dogwood, nannyberry viburnum, Amur privet, common ninebark, northern whitecedar.	White spruce, Manchurian crabapple, Norway spruce.	Red maple, eastern white pine, green ash.	---
Emmet	---	Arrowwood, lilac, nannyberry viburnum, Amur privet, Siberian peashrub.	Siberian crabapple, white spruce, Norway spruce.	Red pine, eastern white pine.	Imperial Carolina poplar.
CtB Croswell	Manyflower cotoneaster.	Lilac, silky dogwood, Amur maple, Amur privet.	Siberian crabapple, white spruce, Norway spruce.	Red pine, eastern white pine.	Imperial Carolina poplar.
CuB Cunard	---	Common ninebark, lilac, Amur privet, northern whitecedar.	Siberian crabapple, white spruce, Norway spruce.	Red pine, green ash, eastern white pine.	Imperial Carolina poplar.
De Deford	---	Nannyberry viburnum, lilac, silky dogwood, American cranberrybush, common ninebark, northern whitecedar.	Amur maple, white spruce, Norway spruce.	Eastern white pine, green ash.	Imperial Carolina poplar, silver maple.
EaC*:					
Emmert	---	Lilac, Siberian crabapple, Manchurian crabapple, Siberian peashrub.	Russian olive, red pine, green ash, jack pine.	Siberian elm, eastern white pine.	---
Pence	Manyflower cotoneaster.	Lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce	Eastern white pine, red pine, jack pine.	---
Sarona	Manyflower cotoneaster.	Siberian peashrub, lilac, American cranberrybush, Amur maple, silky dogwood, gray dogwood.	Norway spruce	Eastern white pine, red pine, jack pine.	---
EaD*: Emmert.					

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
EaD*:					
Pence	Manyflower cotoneaster.	Lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce	Eastern white pine, red pine, jack pine.	---
Sarona	Manyflower cotoneaster.	Siberian peashrub, lilac, American cranberrybush, Amur maple, silky dogwood, gray dogwood.	Norway spruce	Eastern white pine, red pine, jack pine.	---
EmB, EmC, EmD, EmE, EoB, EoC Emmet	---	Arrowwood, lilac, nannyberry viburnum, Amur privet, Siberian peashrub.	Siberian crabapple, white spruce, Norway spruce.	Red pine, eastern white pine.	Imperial Carolina poplar.
Ey. Ensley					
FsB, FsC Fence	---	Northern whitecedar, lilac, silky dogwood, American cranberrybush, Amur maple, gray dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine, red maple, white ash.	---
Fw. Forada					
GaA Gaastra	---	Roselow sargent crabapple, American cranberrybush, nannyberry viburnum, silky dogwood, common ninebark, Amur privet, northern whitecedar.	Manchurian crabapple, white spruce, Norway spruce.	Eastern white pine, green ash.	---
GmB, GmC Goodman	---	Amur maple, northern whitecedar, gray dogwood, lilac, American cranberrybush.	White spruce, Norway spruce, Black Hills spruce.	Eastern white pine, red pine, white ash, red maple.	---
HbB Hibbing	---	Gray dogwood, silky dogwood, Amur maple, American cranberrybush, lilac, northern whitecedar.	White spruce	Red pine, red maple, white ash, silver maple, eastern white pine.	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
IsA--------------- Iosco	---	Northern whitecedar, lilac, American cranberrybush, nannyberry viburnum, silky dogwood, redosier dogwood.	Siberian crabapple, white spruce.	Eastern white pine, red pine, white ash, red maple.	---
IxC*:					
Ishpeming---------	Vanhoutte spirea, manyflower cotoneaster.	Siberian peashrub, lilac, Amur maple, Amur privet.	Washington hawthorn.	Red pine, eastern white pine, jack pine.	---
Rock outcrop.					
KaB, KaC----------- Karlin	Manyflower cotoneaster.	Siberian crabapple, arrowwood, lilac, Amur privet, Siberian peashrub, Amur maple.	Norway spruce-----	Red pine, eastern white pine, jack pine.	Imperial Carolina poplar.
KeB, KeC, KeD----- Keweenaw	Siberian peashrub, manyflower cotoneaster.	Siberian crabapple, lilac, Amur maple, Amur privet.	White spruce, Norway spruce.	Red pine, jack pine, eastern white pine.	Imperial Carolina poplar.
Ls*:					
Loxley.					
Dawson.					
McB, McC, McD----- Mancelona	---	Amur maple, lilac, Siberian peashrub, Amur privet, northern whitecedar.	White spruce, Siberian crabapple, Norway spruce.	Red pine, jack pine, eastern white pine.	Imperial Carolina poplar.
MeB--------------- Manistee	---	Silky dogwood, Amur maple, nannyberry viburnum, lilac, Amur privet, American cranberrybush.	White spruce, Siberian crabapple, Norway spruce.	Red pine, eastern white pine.	---
MhB, MhC, MhD----- Menahga	Manyflower cotoneaster.	Gray dogwood, silky dogwood, Siberian peashrub, American cranberrybush, Amur maple, lilac.	Norway spruce-----	Jack pine, red pine, eastern white pine.	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
MmB*, MmC*, MmD*:					
Menahga	Manyflower cotoneaster.	Gray dogwood, silky dogwood, Siberian peashrub, American cranberrybush, Amur maple, lilac.	Norway spruce	Jack pine, red pine, eastern white pine.	---
Mancelona	Manyflower cotoneaster.	Amur maple, lilac, Siberian peashrub, northern whitecedar.	White spruce, Siberian crabapple, Norway spruce.	Red pine, jack pine, eastern white pine.	Imperial Carolina poplar.
Menominee	Manyflower cotoneaster.	Lilac, silky dogwood, Amur maple, common ninebark, American cranberrybush.	White spruce, Norway spruce.	Eastern white pine, red pine, jack pine.	---
MoB, MoC, MoD: Menominee	Manyflower cotoneaster.	Lilac, silky dogwood, Amur maple, common ninebark, American cranberrybush.	White spruce, Norway spruce.	Eastern white pine, red pine, jack pine.	---
MrC*:					
Michigamme	---	Amur maple, lilac, Siberian peashrub, common ninebark, silky dogwood, Roselow sargent crabapple.	White spruce, Siberian crabapple, Norway spruce.	Eastern white pine, jack pine, red pine.	---
Rock outcrop.					
MsA: Monico	---	Silky dogwood, northern whitecedar, nannyberry viburnum, redosier dogwood, common ninebark, lilac, American cranberrybush.	White spruce	Red maple, eastern white pine, white ash, silver maple.	---
Mt: Moquah	---	Northern whitecedar, lilac, redosier dogwood, silky dogwood, American cranberrybush, nannyberry viburnum.	White spruce	Eastern white pine, red pine, white ash, red maple, silver maple.	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
NaB, NaC: Nadeau	Manyflower cotoneaster.	Lilac, nannyberry viburnum, silky dogwood, common ninebark, gray dogwood, northern whitecedar.	White spruce, Norway spruce.	Eastern white pine, red pine, green ash.	Imperial Carolina poplar.
Nh. Nahma					
PaB, PaC, PaD: Padus	Manyflower cotoneaster.	Gray dogwood, silky dogwood, Siberian peashrub, American cranberrybush, Amur maple, lilac.	Norway spruce	Jack pine, red pine, eastern white pine.	---
PkB, PkC: Pence	Manyflower cotoneaster.	Lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce	Eastern white pine, red pine, jack pine.	---
Pm. Pickford					
Pn. Pinconning					
Pt*. Pits					
Rc. Roscommon					
Rm*: Roscommon.					
Rock outcrop.					
RsB: Rousseau	Vanhoutte spirea, manyflower cotoneaster.	Siberian crabapple, silky dogwood, Amur privet.	White spruce, Norway spruce.	Red pine, eastern white pine, jack pine.	Imperial Carolina poplar.
Sa*: Saprists.					
Psammaquents.					
SbB, SbC, SbD: Sarona	Manyflower cotoneaster.	Siberian peashrub, lilac, American cranberrybush, Amur maple, silky dogwood, gray dogwood.	Norway spruce	Eastern white pine, red pine, jack pine.	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
ScB, ScC: Sayner	Manyflower cotoneaster.	Siberian peashrub, lilac, Amur maple, American cranberrybush, silky dogwood, gray dogwood.	Norway spruce	Eastern white pine, red pine, jack pine.	---
Sd*:					
Seelyeville.					
Markey.					
SeA: Selkirk	American cranberrybush.	Northern whitecedar, silky dogwood, redosier dogwood, common ninebark, lilac, nannyberry viburnum.	White spruce	Red maple, eastern white pine, white ash.	---
SfB, SfC, SfD: Shawano	Manyflower cotoneaster.	Siberian peashrub, lilac, silky dogwood, Amur maple, gray dogwood, American cranberrybush.	Norway spruce	Eastern white pine, red pine, jack pine.	---
SuB, SuC. Summerville					
Ud. Udorthents					
Ur*. Urban land					
WaA: Wainola	---	Silky dogwood, common ninebark, lilac, nannyberry viburnum, American cranberrybush, Amur privet, northern whitecedar.	White spruce, Manchurian crabapple, Norway spruce.	Eastern white pine, jack pine.	---
WrA: Worcester	---	Common ninebark, northern whitecedar, nannyberry viburnum, American cranberrybush, redosier dogwood, silky dogwood, lilac.	White spruce	Eastern white pine, silver maple, red maple, white ash.	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
AdA------------------- Allendale	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
AkC------------------- Alpena	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight----------	Severe: droughty.
AkE------------------- Alpena	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: droughty, slope.
Ar-------------------- Arnheim	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
AuA------------------- Au Gres	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
BaA------------------- Banat	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, droughty.
BnA------------------- Bonduel	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, thin layer, area reclaim.
Bs-------------------- Brevort	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Bv-------------------- Bruce	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
ChA------------------- Charlevoix	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
CmB*:					
Charlevoix-----------	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Emmet----------------	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: large stones.
CtB------------------- Croswell	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
CuB------------------- Cunard	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: small stones, large stones.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
De-------------------- Deford	Severe: ponding, too sandy.	Severe: ponding, too sandy.	Severe: too sandy, ponding.	Severe: ponding, too sandy.	Severe: ponding.
EaC*:					
Emmert---------------	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight----------	Severe: droughty.
Pence----------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: large stones, droughty, slope.
Sarona---------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: large stones, droughty, slope.
EaD*:					
Emmert---------------	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Slight----------	Severe: droughty.
Pence----------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sarona---------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
EmB------------------- Emmet	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: large stones.
EmC------------------- Emmet	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: large stones, slope.
EmD, EmE-------------- Emmet	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
EoB------------------- Emmet	Moderate: large stones.	Moderate: large stones.	Severe: large stones.	Moderate: large stones.	Moderate: large stones.
EoC------------------- Emmet	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: large stones, slope.	Moderate: large stones.	Moderate: large stones, slope.
Ey-------------------- Ensley	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
FsB------------------- Fence	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight----------	Slight.
FsC------------------- Fence	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Fw-------------------- Forada	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
GaA------------------- Gaastra	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
GmB------------------- Goodman	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: large stones.
GmC------------------- Goodman	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: large stones, slope.
HbB------------------- Hibbing	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Slight.
IsA------------------- Iosco	Severe: wetness.	Moderate: wetness, too sandy.	Severe: wetness.	Moderate: wetness, too sandy.	Moderate: wetness, droughty.
IxC*:					
Ishpeming-------------	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: large stones, droughty.
Rock outcrop.					
KaB------------------- Karlin	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: droughty.
KaC------------------- Karlin	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
KeB------------------- Keweenaw	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: large stones, droughty.
KeC------------------- Keweenaw	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: large stones, droughty, slope.
KeD------------------- Keweenaw	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Ls*:					
Loxley----------------	Severe: ponding, excess humus, too acid.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, too acid.	Severe: ponding, excess humus.	Severe: too acid, ponding, excess humus.
Dawson----------------	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
McB------------------- Mancelona	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: small stones, droughty.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
McC: Mancelona	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: small stones, droughty, slope.
McD: Mancelona	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
MeB: Manistee	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Moderate: droughty.
MhB: Menahga	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty.
MhC: Menahga	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: slope, droughty.
MhD: Menahga	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: slope.
MmB*:					
Menahga	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty.
Mancelona	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: small stones, droughty.
Menominee	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
MmC*:					
Menahga	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: slope, droughty.
Mancelona	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: small stones, droughty, slope.
Menominee	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
MmD*:					
Menahga	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: slope.
Mancelona	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Menominee	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too sandy.	Severe: slope.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
MoB: Menominee	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
MoC: Menominee	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
MoD: Menominee	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too sandy.	Severe: slope.
MrC*:					
Michigamme	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, droughty, slope.
Rock outcrop.					
MsA: Monico	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness.
Mt: Moquah	Severe: flooding.	Moderate: percs slowly.	Moderate: flooding, percs slowly.	Slight	Moderate: flooding.
NaB: Nadeau	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
NaC: Nadeau	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
Nh: Nahma	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
PaB: Padus	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones, droughty.
PaC: Padus	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, droughty, slope.
PaD: Padus	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
PkB: Pence	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones, droughty.
PkC: Pence	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, droughty, slope.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Pm: Pickford	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
Pn: Pinconning	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
Pt*. Pits					
Rc: Roscommon	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Rm*:					
Roscommon	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Rock outcrop.					
RsB: Rousseau	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
Sa*:					
Saprists.					
Psammaquents.					
SbB: Sarona	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones, droughty.
SbC: Sarona	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, droughty, slope.
SbD: Sarona	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
ScB: Sayner	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Severe: droughty.
ScC: Sayner	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Severe: droughty.
Sd*:					
Seelyeville	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Markey	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
SeA: Selkirk	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
SfB: Shawano	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
SfC: Shawano	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
SfD: Shawano	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too sandy.	Severe: slope.
SuB: Summerville	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Slight	Severe: thin layer, area reclaim.
SuC: Summerville	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Slight	Severe: thin layer, area reclaim.
Ud. Udorthents					
Ur*. Urban land					
WaA: Wainola	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
WrA: Worcester	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
AdA: Allendale	Fair	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor.
AkC: Alpena	Poor	Poor	Poor	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
AkE: Alpena	Very poor.	Very poor.	Poor	Fair	Fair	Very poor.	Very poor.	Very poor.	Fair	Very poor.
Ar: Arnheim	Very poor.	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
AuA: Au Gres	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
BaA: Banat	Fair	Good	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair.
BnA: Bonduel	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Bs: Brevort	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
Bv: Bruce	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
ChA: Charlevoix	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
CmB*:										
Charlevoix	Fair	Good	Good	Good	Good	Poor	Fair	Good	Good	Very poor.
Emmet	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
CtB: Croswell	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
CuB: Cunard	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
De: Deford	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
EaC*:										
Emmert	Poor	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Pence	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Sarona	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
EaD*:										
Emmert	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.
Pence	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Sarona	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
EmB Emmet	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
EmC Emmet	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
EmD, EmE Emmet	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
EoB Emmet	Poor	Good	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
EoC Emmet	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Ey Ensley	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
FsB Fence	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
FsC Fence	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Fw Forada	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
GaA Gaastra	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
GmB Goodman	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
GmC Goodman	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
HbB Hibbing	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
IsA Iosco	Fair	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Fair.
IxC*:										
Ishpeming	Poor	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Rock outcrop.										
KaB, KaC Karlin	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
KeB---------------- Keweenaw	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
KeC---------------- Keweenaw	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
KeD---------------- Keweenaw	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Ls*:										
Loxley------------	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Dawson------------	Very poor.	Poor	Poor	Poor	Poor	Poor	Good	Poor	Poor	Fair.
McB, McC----------- Mancelona	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
McD---------------- Mancelona	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
MeB---------------- Manistee	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
MhB, MhC----------- Menahga	Poor	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
MhD---------------- Menahga	Very poor.	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
MmB*, MmC*:										
Menahga-----------	Poor	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Mancelona---------	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Menominee---------	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
MmD*:										
Menahga-----------	Very poor.	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Mancelona---------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Menominee---------	Very poor.	Fair	Good	Fair	Fair	Very poor.	Very poor.	Very poor.	Fair	Very poor.
MoB, MoC----------- Menominee	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
MoD---------------- Menominee	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
MrC*:										
Michigamme--------	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
MrC*:										
Rock outcrop.										
MsA---------------- Monico	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Mt----------------- Moquah	Fair	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
NaB, NaC----------- Nadeau	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Nh----------------- Nahma	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Fair.
PaB, PaC----------- Padus	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
PaD---------------- Padus	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
PkB, PkC----------- Pence	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Pm----------------- Pickford	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
Pn----------------- Pinconning	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
Pt*. Pits										
Rc----------------- Roscommon	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
Rm*:										
Roscommon----------	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
Rock outcrop.										
RsB---------------- Rousseau	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Poor.
Sa*:										
Saprists.										
Psammaquents.										
SbB, SbC----------- Sarona	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
SbD---------------- Sarona	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
ScB, ScC----------- Sayner	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
Sd*:										
Seelyeville	Very poor.	Poor	Poor	Fair	Poor	Good	Good	Poor	Fair	Good.
Markey	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
SeA Selkirk	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
SfB, SfC Shawano	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
SfD Shawano	Very poor.	Very poor.	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
SuB Summerville	Fair	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
SuC Summerville	Poor	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Ud. Udorthents										
Ur*. Urban land										
WaA Wainola	Fair	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
WrA Worcester	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AdA: Allendale	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
AkC: Alpena	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
AkE: Alpena	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
Ar: Arnheim	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding.
AuA: Au Gres	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
BaA: Banat	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness, droughty.
BnA: Bonduel	Severe: depth to rock, wetness.	Severe: wetness.	Severe: wetness, depth to rock.	Severe: wetness.	Severe: frost action.	Moderate: wetness, thin layer, area reclaim.
Bs: Brevort	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.
Bv: Bruce	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
ChA: Charlevoix	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness, droughty.
CmB*:						
Charlevoix	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness, droughty.
Emmet	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Moderate: large stones.
CtB: Croswell	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty.
CuB: Cunard	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock, frost action.	Moderate: small stones, large stones.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
De: Deford	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
EaC*:						
Emmert	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, large stones.	Severe: droughty.
Pence	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.
Sarona	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, droughty, slope.
EaD*:						
Emmert	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty.
Pence	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sarona	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
EmB: Emmet	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Moderate: large stones.
EmC: Emmet	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, slope.
EmD, EmE: Emmet	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
EoB: Emmet	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: large stones.
EoC: Emmet	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, slope.
Ey: Ensley	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
FsB: Fence	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Severe: frost action.	Slight.
FsC: Fence	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Fw: Forada	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
GaA: Gaastra	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
GmB: Goodman	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: large stones.
GmC: Goodman	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, slope.
HbB: Hibbing	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
IsA: Iosco	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness, droughty.
IxC*:						
Ishpeming	Severe: depth to rock, cutbanks cave.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Moderate: large stones, droughty.
Rock outcrop.						
KaB: Karlin	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
KaC: Karlin	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
KeB: Keweenaw	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: large stones, droughty.
KeC: Keweenaw	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.
KeD: Keweenaw	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ls*:						
Loxley	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: too acid, ponding, excess humus.
Dawson	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
McB-----------------Mancelona	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: small stones, droughty.
McC-----------------Mancelona	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, droughty, slope.
McD-----------------Mancelona	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
MeB-----------------Manistee	Severe: cutbanks cave.	Slight---------	Severe: shrink-swell.	Moderate: slope.	Slight---------	Moderate: droughty.
MhB-----------------Menahga	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
MhC-----------------Menahga	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope, droughty.
MhD-----------------Menahga	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
MmB*:						
Menahga-----------	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
Mancelona---------	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: small stones, droughty.
Menominee---------	Slight---------	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
MmC*:						
Menahga-----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope, droughty.
Mancelona---------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, droughty, slope.
Menominee---------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
MmD*:						
Menahga-----------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Mancelona---------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
MmD*:						
Menominee	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
MoB Menominee	Slight	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
MoC Menominee	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
MoD Menominee	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
MrC*:						
Michigamme	Severe: depth to rock, cutbanks cave.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope, frost action.	Moderate: large stones, droughty, slope.
Rock outcrop.						
MsA Monico	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: large stones, wetness.
Mt Moquah	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
NaB Nadeau	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: frost action, large stones.	Moderate: droughty.
NaC Nadeau	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, frost action, large stones.	Moderate: droughty, slope.
Nh Nahma	Severe: depth to rock, ponding.	Severe: ponding.	Severe: ponding, depth to rock.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
PaB Padus	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Moderate: large stones, droughty.
PaC Padus	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, droughty, slope.
PaD Padus	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
PkB Pence	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: large stones, droughty.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
PkC: Pence	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.
Pm: Pickford	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.
Pn: Pinconning	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Pt*. Pits						
Rc: Roscommon	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Rm*: Roscommon	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Rock outcrop.						
RsB: Rousseau	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Slight	Moderate: droughty.
Sa*: Saprists.						
Psammaquents.						
SbB: Sarona	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: large stones, droughty.
SbC: Sarona	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, droughty, slope.
SbD: Sarona	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
ScB: Sayner	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
ScC: Sayner	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
Sd*: Seelyeville	Severe: excess humus, ponding.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, excess humus.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Sd*:						
Markey	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
SeA Selkirk	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
SfB Shawano	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
SfC Shawano	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
SfD Shawano	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
SuB Summerville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer, area reclaim.
SuC Summerville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: thin layer, area reclaim.
Ud. Udorthents						
Ur*. Urban land						
WaA Wainola	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
WrA Worcester	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: large stones, wetness, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AdA: Allendale	Severe: wetness, percs slowly, poor filter.	Severe: seepage.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack, wetness.
AkC: Alpena	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
AkE: Alpena	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Ar: Arnheim	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, too sandy.	Severe: flooding, wetness.	Poor: too sandy, wetness.
AuA: Au Gres	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
BaA: Banat	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
BnA: Bonduel	Severe: thin layer, seepage, wetness.	Severe: depth to rock, seepage, wetness.	Severe: depth to rock, seepage, wetness.	Severe: wetness.	Poor: area reclaim, wetness, thin layer.
Bs: Brevort	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Bv: Bruce	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too sandy.	Severe: ponding.	Poor: too sandy, ponding.
ChA: Charlevoix	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
CmB*:					
Charlevoix	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
Emmet	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
CtB: Croswell	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
CuB: Cunard	Severe: thin layer, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Moderate: seepage.	Poor: area reclaim, small stones.
De: Deford	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: too sandy, ponding.
EaC*:					
Emmert	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Pence	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Sarona	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too sandy.	Moderate: slope.	Fair: too sandy, small stones, slope.
EaD*:					
Emmert	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Pence	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Sarona	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
EmB: Emmet	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones.
EmC: Emmet	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: small stones, slope.
EmD, EmE: Emmet	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
EoB: Emmet	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones.
EoC: Emmet	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope, small stones.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ey------------------ Ensley	Severe: ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding.
FsB----------------- Fence	Severe: percs slowly.	Moderate: slope.	Slight-----------	Slight-----------	Good.
FsC----------------- Fence	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Fw------------------ Forada	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
GaA----------------- Gaastra	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
GmB----------------- Goodman	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Poor: thin layer.
GmC----------------- Goodman	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: thin layer.
HbB----------------- Hibbing	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
IsA----------------- Iosco	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
IxC*:					
Ishpeming----------	Severe: thin layer, seepage.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim.
Rock outcrop.					
KaB----------------- Karlin	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
KaC----------------- Karlin	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
KeB----------------- Keweenaw	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage, small stones.
KeC----------------- Keweenaw	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage, small stones.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
KeD: Keweenaw	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
Ls*:					
Loxley	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus, too acid.
Dawson	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
McB: Mancelona	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
McC: Mancelona	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
McD: Mancelona	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
MeB: Manistee	Severe: percs slowly, poor filter.	Severe: seepage.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
MhB: Menahga	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
MhC: Menahga	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
MhD: Menahga	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
MmB*:					
Menahga	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Mancelona	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Menominee	Slight	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: too sandy.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
MmC*:					
Menahga	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Mancelona	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Menominee	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy.	Severe: seepage.	Poor: too sandy.
MmD*:					
Menahga	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Mancelona	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Menominee	Severe: slope.	Severe: seepage, slope.	Severe: too sandy, slope.	Severe: seepage, slope.	Poor: too sandy, slope.
MoB Menominee	Slight	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: too sandy.
MoC Menominee	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy.	Severe: seepage.	Poor: too sandy.
MoD Menominee	Severe: slope.	Severe: seepage, slope.	Severe: too sandy, slope.	Severe: seepage, slope.	Poor: too sandy, slope.
MrC*:					
Michigamme	Severe: thin layer, seepage.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage.	Moderate: seepage, slope.	Poor: depth to rock.
Rock outcrop.					
MsA Monico	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: seepage, small stones, wetness.
Mt Moquah	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too sandy.	Severe: flooding, wetness.	Poor: too sandy.
NaB Nadeau	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
NaC: Nadeau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Nh: Nahma	Severe: thin layer, seepage, ponding.	Severe: depth to rock, seepage, ponding.	Severe: depth to rock, seepage, ponding.	Severe: ponding.	Poor: area reclaim, ponding, thin layer.
PaB: Padus	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
PaC: Padus	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
PaD: Padus	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
PkB: Pence	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
PkC: Pence	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Pm: Pickford	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Pn: Pinconning	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding, too clayey.	Severe: seepage, ponding.	Poor: too clayey, hard to pack, ponding.
Pt*. Pits					
Rc: Roscommon	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Rm*: Roscommon	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Rock outcrop.					

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
RsB: Rousseau	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Sa*:					
Saprists.					
Psammaquents.					
SbB: Sarona	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too sandy.	Slight	Fair: too sandy, small stones.
SbC: Sarona	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too sandy.	Moderate: slope.	Fair: too sandy, small stones, slope.
SbD: Sarona	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
ScB: Sayner	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
ScC: Sayner	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Sd*:					
Seelyeville	Severe: ponding, subsides.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Markey	Severe: subsides, ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
SeA: Selkirk	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
SfB: Shawano	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
SfC: Shawano	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
SfD: Shawano	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
SuB: Summerville	Severe: thin layer, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, large stones.
SuC: Summerville	Severe: thin layer, seepage.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, large stones.
Ud. Udorthents					
Ur*. Urban land					
WaA: Wainola	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.
WrA: Worcester	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
AdA: Allendale	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
AkC: Alpena	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
AkE: Alpena	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Ar: Arnheim	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
AuA: Au Gres	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
BaA: Banat	Poor: wetness.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
BnA: Bonduel	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
Bs: Brevort	Poor: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy, wetness.
Bv: Bruce	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
ChA: Charlevoix	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
CmB*:				
Charlevoix	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Emmet	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
CtB: Croswell	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
CuB: Cunard	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
De: Deford	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
EaC*:				
Emmert	Fair: large stones.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Pence	Good	Probable	Probable	Poor: small stones, area reclaim.
Sarona	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
EaD*:				
Emmert	Poor: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Pence	Poor: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
Sarona	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
EmB, EmC: Emmet	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
EmD, EmE: Emmet	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
EoB, EoC: Emmet	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Ey: Ensley	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
FsB: Fence	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
FsC: Fence	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Fw: Forada	Poor: wetness.	Probable	Probable	Poor: small stones, wetness.
GaA: Gaastra	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
GmB, GmC: Goodman	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, area reclaim.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
HbB------------------- Hibbing	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
IsA------------------- Iosco	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, small stones.
IxC*:				
Ishpeming-------------	Poor: area reclaim.	Improbable: thin layer.	Improbable: too sandy.	Fair: area reclaim, too sandy, thin layer.
Rock outcrop.				
KaB------------------- Karlin	Good-----------------	Probable-------------	Improbable: too sandy.	Fair: too sandy, small stones.
KaC------------------- Karlin	Good-----------------	Probable-------------	Improbable: too sandy.	Fair: too sandy, small stones, slope.
KeB, KeC-------------- Keweenaw	Good-----------------	Probable-------------	Improbable: too sandy.	Poor: small stones, area reclaim.
KeD------------------- Keweenaw	Fair: slope.	Probable-------------	Improbable: too sandy.	Poor: small stones, area reclaim, slope.
Ls*:				
Loxley----------------	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness, too acid.
Dawson----------------	Poor: wetness.	Probable-------------	Probable-------------	Poor: excess humus, wetness.
McB, McC-------------- Mancelona	Good-----------------	Probable-------------	Probable-------------	Poor: too sandy, small stones, area reclaim.
McD------------------- Mancelona	Fair: slope.	Probable-------------	Probable-------------	Poor: too sandy, small stones, area reclaim.
MeB------------------- Manistee	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
MhB, MhC-------------- Menahga	Good-----------------	Probable-------------	Improbable: too sandy.	Poor: too sandy.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
MhD: Menahga	Fair: slope.	Probable	Improbable: too sandy.	Poor: slope, too sandy.
MmB*, MmC*:				
Menahga	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Mancelona	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Menominee	Good	Improbable: thin layer.	Improbable: too sandy.	Poor: thin layer.
MmD*:				
Menahga	Fair: slope.	Probable	Improbable: too sandy.	Poor: slope, too sandy.
Mancelona	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Menominee	Fair: slope.	Improbable: thin layer.	Improbable: too sandy.	Poor: thin layer.
MoB, MoC: Menominee	Good	Improbable: thin layer.	Improbable: too sandy.	Poor: thin layer.
MoD: Menominee	Fair: slope.	Improbable: thin layer.	Improbable: too sandy.	Poor: thin layer.
MrC*:				
Michigamme	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Rock outcrop.				
MsA: Monico	Fair: wetness.	Probable	Probable	Poor: small stones, area reclaim.
Mt: Moquah	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
NaB, NaC: Nadeau	Fair: large stones.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Nh: Nahma	Poor: area reclaim, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, wetness.
PaB, PaC: Padus	Good	Probable	Probable	Poor: small stones, area reclaim.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
PaD: Padus	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
PkB, PkC: Pence	Good	Probable	Probable	Poor: small stones, area reclaim.
Pm: Pickford	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Pn: Pinconning	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
Pt*. Pits				
Rc: Roscommon	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Rm*:				
Roscommon	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Rock outcrop.				
RsB: Rousseau	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
Sa*: Saprists.				
Psammaquents.				
SbB, SbC: Sarona	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
SbD: Sarona	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
ScB, ScC: Sayner	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Sd*:				
Seelyeville	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Markey	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
SeA: Selkirk	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
SfB, SfC: Shawano	Good	Probable	Improbable: too sandy.	Poor: too sandy.
SfD: Shawano	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
SuB, SuC: Summerville	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones, thin layer.
Ud. Udorthents				
Ur*. Urban land				
WaA: Wainola	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
WrA: Worcester	Fair: wetness.	Probable	Probable	Poor: small stones, area reclaim.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
AdA: Allendale	Severe: seepage.	Severe: hard to pack, wetness.	Percs slowly	Wetness, droughty.	Wetness, soil blowing, percs slowly.	Wetness, droughty, percs slowly.
AkC, AkE: Alpena	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty.
Ar: Arnheim	Moderate: seepage.	Severe: seepage, piping, wetness.	Flooding, frost action, cutbanks cave.	Wetness, droughty.	Erodes easily, wetness, too sandy.	Wetness, erodes easily, droughty.
AuA: Au Gres	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
BaA: Banat	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness, droughty.	Wetness, too sandy.	Wetness, droughty.
BnA: Bonduel	Moderate: seepage, depth to rock.	Severe: thin layer, wetness.	Thin layer, frost action.	Wetness, thin layer.	Depth to rock, area reclaim, wetness.	Wetness, depth to rock, area reclaim.
Bs: Brevort	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
Bv: Bruce	Slight	Severe: ponding.	Ponding, frost action, cutbanks cave.	Ponding, soil blowing.	Erodes easily, ponding, too sandy.	Wetness, erodes easily.
ChA: Charlevoix	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action	Wetness, droughty.	Wetness, soil blowing.	Wetness, droughty.
CmB*:						
Charlevoix	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action	Wetness, droughty.	Wetness, soil blowing.	Wetness, droughty.
Emmet	Severe: seepage.	Severe: piping.	Deep to water	Slope, rooting depth.	Soil blowing	Rooting depth.
CtB: Croswell	Severe: seepage.	Severe: seepage, piping.	Slope, cutbanks cave.	Slope, wetness, droughty.	Wetness, too sandy.	Droughty.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
CuB: Cunard	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Slope, droughty, soil blowing.	Depth to rock, area reclaim.	Droughty, depth to rock.
De: Deford	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy, soil blowing.	Wetness, droughty.
EaC*, EaD*:						
Emmert	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, large stones, droughty.	Slope, large stones, too sandy.	Large stones, slope, droughty.
Pence	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
Sarona	Severe: slope.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Slope, too sandy, soil blowing.	Slope, droughty.
EmB: Emmet	Severe: seepage.	Severe: piping.	Deep to water	Slope, rooting depth.	Soil blowing	Rooting depth.
EmC, EmD, EmE: Emmet	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope, rooting depth.	Slope, soil blowing.	Slope, rooting depth.
EoB: Emmet	Severe: seepage.	Severe: piping.	Deep to water	Rooting depth, slope.	Large stones	Rooting depth, large stones.
EoC: Emmet	Severe: seepage, slope.	Severe: piping.	Deep to water	Rooting depth, slope.	Slope, large stones.	Slope, rooting depth, large stones.
Ey: Ensley	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, frost action.	Ponding	Ponding	Wetness.
FsB: Fence	Moderate: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
FsC: Fence	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Fw: Forada	Severe: seepage.	Severe: seepage, ponding.	Ponding, frost action, cutbanks cave.	Ponding	Ponding, too sandy.	Wetness.
GaA: Gaastra	Slight	Severe: piping.	Frost action	Wetness	Erodes easily, wetness.	Wetness, erodes easily.
GmB: Goodman	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
GmC: Goodman	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
HbB--------------- Hibbing	Moderate: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
IsA--------------- Iosco	Severe: seepage.	Severe: piping, wetness.	Frost action---	Wetness, droughty, fast intake.	Wetness, soil blowing.	Wetness, droughty.
IxC*:						
Ishpeming--------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, depth to rock, area reclaim.	Slope, droughty, depth to rock.
Rock outcrop.						
KaB--------------- Karlin	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
KaC--------------- Karlin	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
KeB--------------- Keweenaw	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Large stones, too sandy.	Large stones, droughty.
KeC, KeD---------- Keweenaw	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, large stones, too sandy.	Large stones, slope, droughty.
Ls*:						
Loxley-----------	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, too acid.	Ponding--------	Wetness.
Dawson-----------	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, rooting depth.	Ponding--------	Wetness, rooting depth.
McB--------------- Mancelona	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
McC, McD---------- Mancelona	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
MeB--------------- Manistee	Severe: seepage.	Moderate: hard to pack.	Deep to water	Slope, droughty, fast intake.	Soil blowing, percs slowly.	Droughty, rooting depth.
MhB--------------- Menahga	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
MhC, MhD---------- Menahga	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
MmB*:						
Menahga	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
Mancelona	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
Menominee	Severe: seepage.	Severe: piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
MmC*, MmD*:						
Menahga	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
Mancelona	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
Menominee	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
MoB: Menominee	Severe: seepage.	Severe: piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
MoC, MoD: Menominee	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
MrC*:						
Michigamme	Severe: slope.	Severe: piping.	Deep to water	Slope, droughty, soil blowing.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Rock outcrop.						
MsA: Monico	Moderate: seepage.	Severe: seepage, piping.	Frost action	Wetness, droughty.	Large stones, wetness.	Large stones, wetness.
Mt: Moquah	Moderate: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing, flooding.	Too sandy, soil blowing.	Favorable.
NaB: Nadeau	Severe: seepage.	Severe: seepage.	Deep to water	Slope, large stones, droughty.	Large stones, too sandy.	Large stones, droughty.
NaC: Nadeau	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, large stones, droughty.	Slope, large stones, too sandy.	Large stones, slope, droughty.
Nh: Nahma	Moderate: seepage, depth to rock.	Severe: piping, ponding.	Ponding, thin layer, large stones.	Large stones, ponding, soil blowing.	Large stones, depth to rock, area reclaim.	Large stones, wetness, depth to rock.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
PaB--------------- Padus	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty, rooting depth.
PaC, PaD---------- Padus	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
PkB--------------- Pence	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
PkC--------------- Pence	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
Pm---------------- Pickford	Slight---------	Severe: ponding.	Ponding, percs slowly.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
Pn---------------- Pinconning	Severe: seepage.	Severe: ponding.	Ponding, percs slowly.	Ponding, droughty, fast intake.	Ponding, soil blowing, percs slowly.	Wetness, droughty, percs slowly.
Pt*. Pits						
Rc---------------- Roscommon	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy, soil blowing.	Wetness, droughty.
Rm*: Roscommon--------	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy, soil blowing.	Wetness, droughty.
Rock outcrop.						
RsB--------------- Rousseau	Severe: seepage.	Severe: seepage, piping.	Slope, cutbanks cave.	Slope, droughty, fast intake.	Wetness, too sandy.	Droughty.
Sa*: Saprists.						
Psammaquents.						
SbB--------------- Sarona	Moderate: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty.
SbC, SbD---------- Sarona	Severe: slope.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Slope, too sandy, soil blowing.	Slope, droughty.
ScB--------------- Sayner	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
ScC: Sayner	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
Sd*:						
Seelyeville	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides.	Ponding	Ponding	Wetness.
Markey	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
SeA: Selkirk	Slight	Severe: wetness.	Percs slowly, frost action.	Wetness	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
SfB: Shawano	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
SfC, SfD: Shawano	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
SuB: Summerville	Severe: depth to rock, seepage.	Severe: piping, large stones, thin layer.	Deep to water	Slope, droughty, thin layer.	Depth to rock, area reclaim.	Depth to rock, area reclaim.
SuC: Summerville	Severe: depth to rock, seepage, slope.	Severe: piping, large stones, thin layer.	Deep to water	Slope, droughty, thin layer.	Slope, depth to rock, area reclaim.	Depth to rock, area reclaim.
Ud. Udorthents						
Ur*. Urban land						
WaA: Wainola	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
WrA: Worcester	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness, droughty, soil blowing.	Wetness, too sandy, soil blowing.	Wetness, droughty, rooting depth.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
AdA-------------- Allendale	0-3	Loamy sand-------	SM, SP-SM	A-2-4, A-1-b, A-4	0	95-100	90-100	45-80	10-40	---	NP
	3-27	Sand, loamy sand, fine sand.	SM, SP-SM	A-2-4, A-3, A-4, A-1-b	0	95-100	90-100	45-80	5-40	---	NP
	27-60	Silty clay, clay	CH, MH	A-7	0	100	90-100	90-100	75-95	50-70	20-40
AkC, AkE--------- Alpena	0-8	Gravelly sandy loam.	SM, SM-SC, SP-SM	A-2-4, A-1	0-10	75-90	50-75	10-55	5-35	<25	NP-7
	8-60	Stratified very gravelly sand to sand.	SP, SP-SM, GP, GP-GM	A-1	0-10	35-75	25-50	10-35	0-10	---	NP
Ar--------------- Arnheim	0-3	Silt loam--------	ML, CL-ML, SM, SM-SC	A-4	0	100	100	90-100	40-90	<25	NP-6
	3-60	Stratified silt loam to sand.	ML, SM, CL, SC	A-2-4, A-4, A-3	0	100	100	50-100	5-90	<30	NP-10
AuA-------------- Au Gres	0-3	Loamy sand-------	SM, SP-SM, SM-SC	A-2-4, A-1-b	0	95-100	85-100	40-75	10-30	<25	NP-7
	3-29	Sand, loamy sand	SP-SM, SM, SM-SC	A-2-4, A-3, A-1-b	0	95-100	85-100	40-75	5-30	<25	NP-7
	29-60	Sand-------------	SP-SM, SM	A-3, A-2-4, A-1-b	0	95-100	85-100	40-60	5-15	---	NP
BaA-------------- Banat	0-13	Sandy loam-------	ML, SM, CL, SC	A-2-4, A-4, A-1-b	0-10	95-100	75-100	45-85	20-55	<30	NP-10
	13-23	Very gravelly sandy loam, gravelly sandy loam, very gravelly loam.	GM, GW-GM, SM, SP-SM	A-1, A-2-4, A-4	0-15	40-65	20-55	15-50	10-40	<30	NP-10
	23-60	Very gravelly loamy sand, extremely gravelly coarse sand, very gravelly sand.	GW, GW-GM, SP, SP-SM	A-1	0-15	40-75	20-55	10-35	0-10	---	NP
BnA-------------- Bonduel	0-6	Loam-------------	ML, CL, CL-ML	A-4	0	90-100	90-100	80-100	50-95	20-30	3-10
	6-15	Sandy clay loam, loam, silt loam.	CL, SC	A-4, A-6	0-5	90-100	90-100	75-100	35-90	25-40	7-20
	15-28	Loam, fine sandy loam, sandy loam.	CL, ML, SC, SM	A-4, A-6, A-2, A-1	0-5	70-95	70-95	40-90	20-70	<30	NP-12
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Bs---------------- Brevort	0-7	Sapric material	PT	A-8	---	---	---	---	---	---	---
	7-14	Loamy fine sand, mucky loamy fine sand.	SM, SC, ML, CL	A-4, A-2	0	90-100	75-100	70-85	15-55	<25	2-9
	14-39	Fine sand, sand, loamy sand.	SP, SM, SP-SM	A-3, A-2, A-1-b	0	90-100	75-100	35-80	2-35	---	NP
	39-60	Sandy loam, fine sandy loam, loam.	SC, SM-SC, CL, CL-ML	A-2, A-4, A-6	0-10	85-100	65-100	55-95	15-70	20-30	4-11
Bv---------------- Bruce	0-7	Fine sandy loam	ML, CL-ML, SM, SM-SC	A-4	0	100	100	70-95	40-65	<30	2-10
	7-13	Silt loam, fine sandy loam, very fine sandy loam.	CL-ML, ML, CL	A-4	0	100	100	85-100	50-80	20-35	2-10
	13-25	Silty clay loam, silt loam.	CL	A-6, A-4	0	100	100	90-100	70-80	25-40	8-16
	25-60	Stratified silt to fine sand.	CL, SC	A-4, A-6	0	100	100	70-95	40-85	25-40	8-16
ChA--------------- Charlevoix	0-4	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-2-4, A-4, A-1-b	0-5	90-100	75-100	40-95	20-55	<25	2-7
	4-20	Sandy loam, fine sandy loam, loam.	SC, SM-SC, CL, CL-ML	A-2-4, A-4, A-1-b	0-5	90-100	75-100	45-95	20-55	20-30	4-10
	20-27	Sandy clay loam, loam, sandy loam.	CL-ML, SC, SM-SC, CL	A-6, A-4, A-2, A-7	0-5	90-100	75-100	45-95	20-75	25-45	7-20
	27-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SC, SM-SC, SM	A-4, A-2-4, A-1-b	0-5	85-95	75-95	35-80	15-50	<30	NP-10
CmB*:											
Charlevoix-------	0-4	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-2-4, A-4, A-1-b	0-5	90-100	75-100	40-95	20-55	<25	2-7
	4-20	Sandy loam, fine sandy loam, loam.	SC, SM-SC, CL, CL-ML	A-2-4, A-4, A-1-b	0-5	90-100	75-100	45-95	20-55	20-30	4-10
	20-27	Sandy clay loam, loam, sandy loam.	CL-ML, SC, SM-SC, CL	A-6, A-4, A-2, A-7	0-5	90-100	75-100	45-95	20-75	25-45	7-20
	27-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SC, SM-SC, SM	A-4, A-2-4, A-1-b	0-5	85-95	75-95	35-80	15-50	<30	NP-10
Emmet------------	0-4	Fine sandy loam	SM, SM-SC, SC	A-2, A-1-b, A-4	0-8	90-100	75-100	45-85	20-50	<25	NP-10
	4-13	Sandy loam, loamy sand, fine sandy loam.	SM, SC, ML, CL	A-2, A-1-b, A-4	0-8	95-100	75-100	35-85	10-55	<25	NP-10
	13-33	Fine sandy loam, sandy loam, loam.	SM-SC, CL, CL-ML, SC	A-2, A-4, A-6, A-1-b	0-8	95-100	75-100	45-95	20-75	20-40	5-20
	33-60	Sandy loam, fine sandy loam, gravelly fine sandy loam.	SM, SM-SC, SC	A-2, A-4, A-1-b	0-8	85-95	60-95	45-80	20-50	<25	NP-10

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag-ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
CtB-------------- Croswell	0-8	Loamy sand-------	SM, SP-SM, SM-SC	A-2, A-1-b	0	90-100	85-100	40-65	10-30	<25	NP-7
	8-30	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	85-100	40-75	3-30	---	NP
	30-60	Sand-------------	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	85-100	40-70	3-15	---	NP
CuB-------------- Cunard	0-5	Loam-------------	ML, CL-ML	A-4	0-15	90-100	75-100	60-95	50-75	<25	NP-7
	5-24	Loam, fine sandy loam, sandy loam.	ML, SM-SC, SM, CL-ML	A-2-4, A-4, A-1-b	0-15	85-100	70-100	40-95	20-75	<30	NP-10
	24-29	Loam, fine sandy loam, gravelly sandy loam.	ML, SM-SC, SM, CL-ML	A-2-4, A-4, A-1-b	0-15	65-95	60-95	35-95	15-75	<30	NP-10
	29	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
De--------------- Deford	0-2	Mucky fine sand	SM	A-2-4	0	100	100	50-80	15-35	<20	NP-4
	2-60	Fine sand, very fine sand, loamy fine sand.	SM	A-2-4, A-4	0	100	100	50-80	15-40	<20	NP-4
EaC*, EaD*:											
Emmert----------	0-2	Gravelly sandy loam.	SM, SM-SC	A-1, A-2-4	0-10	80-90	65-85	30-60	20-35	<20	NP-4
	2-60	Gravelly loamy sand, very gravelly sand, gravelly sand.	GW, GP, SP, SW	A-1	0-30	20-60	10-45	5-25	0-5	---	NP
Pence-----------	0-1	Sandy loam-------	SM, ML	A-4, A-2, A-1	0-7	85-100	75-100	45-85	20-55	<21	NP-4
	1-14	Sandy loam, loam, fine sandy loam.	SM, ML, CL-ML, SM-SC	A-4, A-2, A-1	0-7	55-100	50-100	30-95	15-75	<25	NP-7
	14-21	Gravelly sand, coarse sand, sand.	SM, SP-SM, GM, GP-GM	A-2, A-1, A-3	0-8	55-100	50-100	25-75	2-30	---	NP
	21-60	Gravelly sand, sand, sand and gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-15	30-100	25-100	10-70	1-12	---	NP
Sarona----------	0-4	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-2, A-4	0-7	75-100	75-100	45-85	25-55	<20	2-7
	4-28	Sandy loam, fine sandy loam, loam.	SM, SM-SC, ML, CL-ML	A-2, A-4, A-1	0-7	75-100	75-100	40-95	12-55	<20	NP-7
	28-38	Sandy loam, loam, gravelly sandy loam.	SM, SM-SC	A-2, A-1, A-4	0-7	65-100	65-100	40-90	12-40	<20	NP-7
	38-60	Loamy sand, sandy loam, gravelly sandy loam.	SM, SM-SC	A-2, A-1, A-4	0-7	65-95	65-95	40-80	12-40	<20	NP-7

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
EmB, EmC, EmD, EmE-------------- Emmet	0-3	Fine sandy loam	SM, SM-SC, SC	A-2, A-1-b, A-4	0-8	90-100	75-100	45-85	20-50	<25	NP-10
	3-13	Sandy loam, loamy sand, fine sandy loam.	SM, SC, ML, CL	A-2, A-1-b, A-4	0-8	95-100	75-100	35-85	10-55	<25	NP-10
	13-33	Fine sandy loam, sandy loam, loam.	SM-SC, CL, CL-ML, SC	A-2, A-4, A-6, A-1-b	0-8	95-100	75-100	45-95	20-75	20-40	5-20
	33-60	Sandy loam, fine sandy loam, gravelly fine sandy loam.	SM, SM-SC, SC	A-2, A-4, A-1-b	0-8	85-95	60-95	45-80	20-50	<25	NP-10
EoB, EoC--------- Emmet	0-7	Cobbly fine sandy loam.	SM, SM-SC, SC	A-2, A-1-b, A-4	20-30	90-100	65-75	45-75	20-50	<25	NP-10
	7-13	Sandy loam, loamy sand, fine sandy loam.	SM, SM-SC, SC, ML	A-2, A-4, A-1-b	5-15	95-100	75-100	35-85	10-55	<25	NP-10
	13-26	Fine sandy loam, sandy loam, loam.	SM-SC, CL, CL-ML, SC	A-2, A-4, A-6, A-1-b	5-15	95-100	75-100	45-85	20-75	20-40	5-20
	26-60	Sandy loam, fine sandy loam, gravelly fine sandy loam.	SM, SM-SC, SC	A-2, A-4, A-1-b	5-15	85-95	65-95	45-80	20-50	<25	NP-10
Ey--------------- Ensley	0-5	Loam-------------	CL-ML, CL	A-4, A-6	0-5	90-100	75-100	65-95	50-80	20-30	4-11
	5-25	Loam, sandy clay loam, fine sandy loam.	SC, SM-SC, CL, CL-ML	A-6, A-4, A-2, A-1	0-10	90-100	75-100	45-90	20-55	20-35	4-15
	25-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM-SC, SM, SC	A-2, A-4, A-1	0-10	85-95	65-95	35-80	15-50	<30	2-9
FsB, FsC--------- Fence	0-2	Silt loam--------	ML, CL-ML, CL	A-4	0	100	100	90-100	70-100	20-35	NP-10
	2-17	Silt loam, silt, very fine sandy loam.	ML, CL, SM, SC	A-4	0	100	100	85-100	40-100	<30	NP-9
	17-39	Silt loam, very fine sandy loam, silt.	ML, CL-ML, CL	A-4, A-6	0	100	100	85-100	70-100	<30	NP-12
	39-60	Stratified silt to very fine sand.	ML, CL-ML	A-4	0	100	100	85-100	50-100	<25	NP-7
Fw--------------- Forada	0-9	Mucky loam-------	ML	A-4	0	95-100	85-100	70-90	50-70	25-35	NP-10
	9-26	Sandy loam, loam, fine sandy loam.	ML, SM	A-4, A-2	0	95-100	85-100	55-85	30-60	20-40	NP-10
	26-60	Sand, coarse sand, gravelly coarse sand.	SP, SM, SP-SM, GP-GM	A-1, A-2, A-3	0	50-90	50-80	40-70	2-30	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
GaA-------------- Gaastra	0-3	Silt loam--------	CL-ML, CL	A-4	0	100	100	85-100	50-90	20-30	5-10
	3-26	Silt loam, very fine sandy loam, fine sandy loam.	CL-ML, CL, SC, SM-SC	A-4, A-6	0	100	100	85-100	40-90	20-35	5-15
	26-60	Silt loam, silt, very fine sandy loam.	CL-ML, CL, SC, SM-SC	A-4	0	100	100	85-100	40-90	20-30	5-10
GmB, GmC--------- Goodman	0-4	Silt loam--------	ML, CL-ML	A-4	0-15	90-100	90-100	80-100	65-95	<23	NP-6
	4-35	Silt loam--------	ML, CL-ML	A-4	0-15	95-100	90-100	85-100	55-85	<27	NP-7
	35-37	Fine sandy loam, sandy loam, loam.	SM, SM-SC, ML, CL-ML	A-2, A-1, A-4, A-3	0-15	65-100	60-95	30-90	7-70	<25	NP-7
	37-60	Sandy loam, gravelly sandy loam, loamy sand.	SM, SM-SC, SP-SM	A-2, A-1, A-3	0-15	65-100	60-95	30-80	7-35	<23	NP-6
HbB-------------- Hibbing	0-5	Silt loam--------	ML	A-4	0-1	95-100	85-100	80-85	50-75	<25	NP-4
	5-30	Clay, silty clay, silty clay loam.	CL, CH	A-7	0-1	95-100	85-100	85-100	70-95	40-60	15-35
	30-60	Clay, silty clay	CL, CH	A-7	0-1	95-100	85-100	85-100	70-95	40-60	15-35
IsA-------------- Iosco	0-9	Loamy fine sand	SM, SC, SP-SM, SM-SC	A-4, A-1, A-2	0-5	90-100	75-100	35-85	10-45	<25	2-9
	9-24	Fine sand, sand, loamy sand.	SP-SM, SM	A-3, A-2, A-4, A-1	0-5	90-100	75-100	35-80	5-45	---	NP
	24-28	Loam, fine sandy loam, gravelly sandy clay loam.	CL, SC	A-4, A-6, A-2	0-10	85-100	60-100	45-95	20-75	26-35	8-15
	28-60	Fine sandy loam, loam, gravelly sandy loam.	SC, CL, ML, SM	A-2, A-4, A-1	0-10	85-100	60-100	35-95	15-75	20-30	NP-10
IxC*:											
Ishpeming-------	0-6	Loamy fine sand	SM, SP-SM, SM-SC	A-2-4, A-1-b, A-4	0-15	90-100	85-100	40-100	10-50	<25	NP-7
	6-36	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM, SM-SC	A-1-b, A-2-4, A-3, A-4	0-15	90-100	85-100	40-100	5-50	<25	NP-7
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
KaB, KaC--------- Karlin	0-2	Loamy fine sand	SM, SP-SM	A-2, A-4	0	90-100	75-100	60-100	10-45	---	NP-4
	2-17	Loamy fine sand, loamy sand, sandy loam.	SP-SM, SM, ML	A-2, A-4	0	90-100	75-100	60-100	10-55	<20	NP-4
	17-30	Loamy fine sand, fine sand, sand.	SP, SP-SM, SM	A-2, A-3, A-1	0	90-100	75-100	35-80	0-35	---	NP
	30-60	Sand-------------	SP, SP-SM, SM	A-2, A-3, A-1	0	80-100	75-100	35-70	0-15	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
KeB, KeC, KeD---- Keweenaw	0-4	Loamy sand-------	SM, SC, SM-SC, SP-SM	A-2, A-1-b, A-4	0-10	90-100	75-100	35-85	10-40	<20	NP-10
	4-24	Loamy sand, gravelly loamy sand, sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b, A-4, A-3	0-25	85-100	65-100	30-85	5-45	<20	NP-10
	24-36	Fine sandy loam, sandy loam, gravelly loamy sand.	SM, SC, SP-SM, ML	A-2, A-3, A-1-b, A-4	0-25	85-100	65-100	30-85	5-55	<30	NP-10
	36-60	Loamy sand, gravelly loamy sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b	0-25	85-100	65-100	30-75	10-30	<20	NP-10
Ls*:											
Loxley----------	0-15	Fibric material	PT	A-8	0	---	---	---	---	---	---
	15-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
Dawson----------	0-8	Fibric material	PT	A-8	0	---	---	---	---	---	---
	8-36	Sapric material	PT	A-8	0	---	---	---	---	---	---
	36-60	Sand, gravelly sand, fine sand.	SM-SC, SM, SC, SP-SM	A-2, A-3, A-1	0	45-100	35-100	15-90	0-35	<20	NP-10
McB, McC, McD---- Mancelona	0-6	Loamy sand-------	SM, SP-SM	A-2, A-1-b	0-8	90-100	75-95	35-80	10-35	---	NP
	6-21	Loamy sand, sand, gravelly loamy sand.	SM, SP-SM	A-2, A-1-b, A-3	0-8	80-100	55-95	30-75	5-30	---	NP
	21-32	Loamy sand, sandy clay loam, gravelly loamy sand.	SM-SC, SC, SP-SC	A-2, A-4, A-6, A-1	0-8	85-100	55-95	35-80	10-50	20-35	4-15
	32-60	Very gravelly sand, gravelly sand, sand.	GP, SP, GW, SW	A-1, A-2, A-3	0-8	40-90	30-85	20-60	0-15	---	NP
MeB-------------- Manistee	0-3	Loamy sand-------	SM, SP-SM	A-2-4, A-4, A-1-b	0	95-100	90-100	45-85	10-45	---	NP
	3-28	Sand, loamy sand, fine sand.	SP-SM, SM	A-2-4, A-1-b, A-3	0-2	95-100	90-100	45-80	5-35	---	NP
	28-36	Clay, silty clay, clay loam.	CH, CL	A-7	0	95-100	90-100	85-100	75-95	40-65	20-40
	36-60	Clay, silty clay, clay loam.	CH, CL	A-7	0	95-100	90-100	85-100	70-95	40-65	20-40
MhB, MhC, MhD---- Menahga	0-2	Sand-------------	SP, SP-SM	A-3, A-2	0	100	85-100	50-75	0-10	---	NP
	2-25	Coarse sand, sand, loamy sand.	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
	25-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
MmB*, MmC*, MmD*:											
Menahga---------	0-2	Sand-------------	SP, SP-SM	A-3, A-2	0	100	85-100	50-75	0-10	---	NP
	2-25	Coarse sand, sand, loamy sand.	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
	25-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
MmB*, MmC*, MmD*:											
Mancelona--------	0-6	Loamy sand--------	SM, SP-SM	A-2, A-1-b	0-8	90-100	75-95	35-80	10-35	---	NP
	6-21	Loamy sand, sand, gravelly loamy sand.	SM, SP-SM	A-2, A-1-b, A-3	0-8	80-100	55-95	30-75	5-30	---	NP
	21-32	Loamy sand, sandy clay loam, gravelly loamy sand.	SM-SC, SC, SP-SC	A-2, A-4, A-6, A-1	0-8	85-100	55-95	35-80	10-50	20-35	4-15
	32-60	Very gravelly sand, gravelly sand, sand.	GP, SP, GW, SW	A-1, A-2, A-3	0-8	40-90	30-85	20-60	0-15	---	NP
Menominee--------	0-8	Loamy sand--------	SM	A-2, A-4	0	100	100	50-80	15-40	---	NP
	8-36	Fine sand, loamy sand, sand.	SM, ML, SP-SM	A-2, A-4, A-3	0	100	100	50-80	5-55	---	NP
	36-50	Fine sandy loam, loam, sandy clay loam.	SC, SM, CL, ML	A-4, A-6	0-10	95-100	85-100	80-100	35-80	20-40	NP-20
	50-60	Sandy loam, loam, fine sandy loam.	SC, SM, CL, ML	A-4, A-6, A-2	0-10	85-100	75-100	60-95	30-75	<30	NP-12
MoB, MoC, MoD----- Menominee	0-8	Loamy sand--------	SM	A-2, A-4	0	100	100	50-80	15-40	---	NP
	8-36	Fine sand, loamy sand, sand.	SM, ML, SP-SM	A-2, A-4, A-3	0	100	100	50-80	5-55	---	NP
	36-50	Fine sandy loam, loam, sandy clay loam.	SC, SM, CL, ML	A-4, A-6	0-10	95-100	85-100	80-100	35-80	20-40	NP-20
	50-60	Sandy loam, loam, fine sandy loam.	SC, SM, CL, ML	A-4, A-6, A-2	0-10	85-100	75-100	60-95	30-75	<30	NP-12
MrC*:											
Michigamme-------	0-2	Fine sandy loam	SM	A-2-4, A-4, A-1-b	0-20	95-100	75-100	45-80	20-50	<25	NP-4
	2-24	Very fine sandy loam, fine sandy loam, sandy loam.	SM, ML, SM-SC, CL-ML	A-2-4, A-4, A-1-b	0-20	95-100	75-100	45-95	20-80	<25	NP-7
	24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
MsA--------------- Monico	0-8	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-2, A-4, A-1	0-25	85-100	75-100	40-85	20-55	<25	NP-7
	8-26	Silt loam, very fine sandy loam, fine sandy loam.	SM, SC, ML, CL	A-2, A-4, A-1	0-25	65-100	60-95	50-95	30-85	<30	NP-10
	26-60	Gravelly loamy sand, loamy sand, sandy loam.	SM, SM-SC, GM, GP-GM	A-1, A-2	0-25	60-100	60-95	30-85	10-35	<20	NP-4
Mt---------------- Moquah	0-12	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	100	60-95	30-65	10-19	2-7
	12-60	Stratified silt loam to sand.	ML, SM, SC, CL	A-2, A-4	0	100	100	65-100	15-70	<28	NP-9

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
NaB, NaC---------- Nadeau	0-2	Fine sandy loam	SM, SC, SM-SC, ML	A-2-4, A-4, A-1-b	0-5	85-100	75-100	45-85	20-55	<25	NP-10
	2-14	Loam, fine sandy loam, sandy loam.	SM, SC, ML, CL	A-2-4, A-4, A-1-b	0-5	85-100	75-100	45-95	20-75	20-30	3-10
	14-20	Very gravelly sandy loam, very gravelly loam, very gravelly fine sandy loam.	GM, GC, GP-GM, GM-GC	A-1, A-2-4, A-4	5-45	40-65	30-55	15-50	10-50	20-30	3-10
	20-60	Very gravelly loamy sand, very gravelly sand.	GW, SW, SW-SM, GP	A-1	5-45	40-75	30-60	10-35	0-15	---	NP
Nh---------------- Nahma	0-9	Sapric material	PT	A-8	0	---	---	---	---	---	---
	9-40	Sandy loam, loam, fine sandy loam.	SM, ML, CL-ML, SM-SC	A-4, A-2	0-20	90-100	75-100	45-95	20-75	20-30	2-9
	40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
PaB, PaC, PaD---- Padus	0-5	Fine sandy loam	SM	A-2, A-4, A-1-b	0-7	80-100	75-100	45-85	20-50	<25	NP-4
	5-24	Fine sandy loam, sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-1-b	0-7	80-100	75-100	45-95	20-90	<30	NP-10
	24-27	Loamy sand, sand, gravelly sandy loam.	SM, SP, GP, GM	A-2, A-4, A-1, A-3	0-7	50-100	45-100	25-75	2-40	<25	NP-4
	27-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-2, A-3	0-7	30-100	25-100	10-70	1-12	---	NP
PkB, PkC---------- Pence	0-2	Sandy loam--------	SM, ML	A-4, A-2, A-1	0-7	85-100	75-100	45-85	20-55	<21	NP-4
	2-14	Sandy loam, loam, fine sandy loam.	SM, ML, CL-ML, SM-SC	A-4, A-2, A-1	0-7	55-100	50-100	30-95	15-75	<25	NP-7
	14-21	Gravelly sand, coarse sand, sand.	SM, SP-SM, GM, GP-GM	A-2, A-1, A-3	0-8	55-100	50-100	25-75	2-30	---	NP
	21-60	Gravelly sand, sand, sand and gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-15	30-100	25-100	10-70	1-12	---	NP
Pm---------------- Pickford	0-6	Mucky silty clay loam.	CL	A-7, A-6	0	100	100	90-100	70-95	30-50	10-25
	6-20	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	75-95	40-70	20-40
	20-60	Clay, silty clay	CH, CL	A-7	0	100	100	90-100	75-95	45-70	25-40
Pn---------------- Pinconning	0-8	Loamy sand--------	SM, SP-SM	A-2-4, A-3	0	100	95-100	50-75	5-35	---	NP
	8-27	Sand, loamy sand, fine sand.	SP-SM, SM	A-3, A-2-4	0	100	95-100	50-80	5-35	---	NP
	27-60	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	95-100	90-100	75-95	40-60	25-35
Pt*. Pits											

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Rc---------------- Roscommon	0-7	Mucky loamy sand	SM, SP-SM, SM-SC	A-2, A-1-b	0	95-100	85-100	40-75	10-30	<23	NP-6
	7-60	Sand, loamy sand, coarse sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-75	0-30	<20	NP-4
Rm*:											
Roscommon--------	0-7	Mucky loamy sand	SM, SP-SM, SM-SC	A-2, A-1-b	0	95-100	85-100	40-75	10-30	<23	NP-6
	7-60	Sand, loamy sand, coarse sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-75	0-30	<20	NP-4
Rock outcrop.											
RsB--------------- Rousseau	0-2	Loamy fine sand	SM	A-2-4, A-4	0	100	100	75-95	25-45	---	NP
	2-32	Fine sand, loamy fine sand.	SM	A-2-4	0	100	100	65-100	20-35	---	NP
	32-60	Fine sand, sand	SP-SM, SM	A-2-4, A-3	0	100	100	85-100	5-35	---	NP
Sa*:											
Saprists.											
Psammaquents.											
SbB, SbC, SbD---- Sarona	0-4	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-2, A-4	0-7	75-100	75-100	45-85	25-55	<20	2-7
	4-28	Sandy loam, fine sandy loam, loam.	SM, SM-SC, ML, CL-ML	A-2, A-4, A-1	0-7	75-100	75-100	40-95	12-55	<20	NP-7
	28-38	Sandy loam, loam, gravelly sandy loam.	SM, SM-SC	A-2, A-1, A-4	0-7	65-100	65-100	40-90	12-40	<20	NP-7
	38-60	Loamy sand, sandy loam, gravelly sandy loam.	SM, SM-SC	A-2, A-1, A-4	0-7	65-95	65-95	40-80	12-40	<20	NP-7
ScB, ScC---------- Sayner	0-3	Loamy sand--------	SM, SP-SM	A-1, A-2	0-15	80-100	75-100	35-75	10-30	---	NP
	3-25	Loamy sand, sand, gravelly sand.	SP, SM, GP, GM	A-1, A-3, A-2	0-15	50-100	50-100	20-75	0-30	---	NP
	25-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-15	50-90	40-85	0-55	0-10	---	NP
Sd*:											
Seelyeville------	0-12	Sapric material	PT	A-8	0	---	---	---	---	---	---
	12-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
Markey-----------	0-21	Sapric material	PT	A-8	---	---	---	---	---	---	---
	21-60	Sand, loamy sand, fine sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	95-100	75-100	35-75	0-30	---	NP
SeA--------------- Selkirk	0-10	Silt loam---------	CL-ML, CL	A-4, A-6	0-5	90-100	85-100	70-100	50-90	25-40	5-20
	10-28	Clay, silty clay, silty clay loam.	CH	A-7	0-5	90-100	85-100	80-100	65-95	50-70	25-40
	28-60	Clay, silty clay	CH	A-7	0-5	90-100	85-100	80-100	65-95	50-70	25-40
SfB, SfC, SfD---- Shawano	0-2	Loamy fine sand	SM	A-2, A-4	0	95-100	95-100	75-100	30-40	---	NP
	2-26	Fine sand---------	SM, SP-SM	A-2, A-3	0	95-100	95-100	65-100	5-35	---	NP
	26-60	Fine sand, very fine sand, sand.	SP, SM, SP-SM, ML	A-2, A-3, A-1, A-4	0	95-100	95-100	45-100	2-55	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
SuB, SuC--------- Summerville	0-9	Fine sandy loam	SM-SC, SC, CL, CL-ML	A-2-4, A-4	0-10	95-100	90-100	55-85	25-55	20-30	4-10
	9-17	Fine sandy loam, sandy loam, loam.	SM-SC, SC, CL, CL-ML	A-2-4, A-4, A-2-6, A-6	0-15	95-100	90-100	55-95	25-75	20-35	4-15
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ud. Udorthents											
Ur*. Urban land											
WaA-------------- Wainola	0-2	Loamy fine sand	SM	A-2-4	0	100	90-100	55-80	20-35	---	NP
	2-18	Fine sand, loamy fine sand, very fine sand.	SM, ML	A-2-4, A-4	0	100	90-100	50-80	15-55	---	NP
	18-60	Fine sand, loamy fine sand, very fine sand.	SM, ML	A-2-4, A-4	0	100	90-100	50-80	15-55	---	NP
WrA-------------- Worcester	0-2	Fine sandy loam	SM, SM-SC	A-2, A-4	0-7	80-100	75-100	45-85	25-50	<20	2-7
	2-24	Loam, fine sandy loam, sandy loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0-7	80-100	75-100	35-95	12-80	<20	2-7
	24-30	Loam, sandy loam, gravelly sandy loam.	SM, SC, ML, CL	A-2, A-4, A-1	0-7	50-100	45-100	25-95	10-80	15-25	3-10
	30-60	Sand, gravelly sand, very gravelly sand.	SP, SP-SM, GP, GP-GM	A-1, A-2, A-3	0-7	30-100	25-100	10-70	1-12	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
AdA	0-3	0-12	1.25-1.40	6.0-20	0.09-0.12	4.5-7.3	Low	0.17	4	2	1-3
Allendale	3-27	0-15	1.35-1.45	6.0-20	0.06-0.10	4.5-7.3	Low	0.17			
	27-60	40-60	1.45-1.70	0.06-0.2	0.08-0.12	6.1-8.4	Moderate	0.32			
AkC, AkE	0-8	5-15	1.25-1.55	2.0-20	0.05-0.14	6.6-7.8	Low	0.10	2	8	2-4
Alpena	8-60	0-10	1.25-1.65	>20	0.02-0.04	7.9-8.4	Low	0.10			
Ar	0-3	12-18	1.15-1.60	0.6-6.0	0.12-0.35	5.1-7.3	Low	0.37	5	8	2-4
Arnheim	3-60	5-18	1.50-1.80	0.6-2.0	0.05-0.22	5.1-7.3	Low	0.37			
AuA	0-3	10-15	1.30-1.55	6.0-20	0.07-0.09	3.6-7.3	Low	0.17	5	2	.5-8
Au Gres	3-29	1-15	1.50-1.70	6.0-20	0.06-0.09	4.5-7.3	Low	0.15			
	29-60	0-8	1.50-1.70	6.0-20	0.05-0.07	5.1-7.3	Low	0.15			
BaA	0-13	2-18	1.30-1.60	0.6-2.0	0.12-0.18	5.6-7.3	Low	0.24	3	3	1-3
Banat	13-23	2-8	1.35-1.60	0.6-2.0	0.04-0.09	6.6-7.8	Low	0.17			
	23-60	0-5	1.50-1.70	>20	0.01-0.04	7.4-8.4	Low	0.10			
BnA	0-6	5-20	1.35-1.55	0.6-2.0	0.19-0.24	6.6-7.8	Low	0.32	4	5	2-3
Bonduel	6-15	18-27	1.55-1.65	0.6-2.0	0.15-0.22	6.6-7.8	Moderate	0.32			
	15-28	2-25	1.65-1.70	0.6-2.0	0.09-0.18	6.6-8.4	Low	0.32			
	28	---	---	---	---	---	---	---			
Bs	0-7	---	0.10-0.25	2.0-6.0	0.35-0.45	5.6-7.3	---	---	5	2	60-80
Brevort	7-14	5-15	1.35-1.70	2.0-6.0	0.10-0.12	5.6-7.3	Low	0.17			
	14-39	2-5	1.45-1.60	6.0-20	0.07-0.09	6.6-7.8	Low	0.17			
	39-60	10-20	1.30-1.70	0.6-2.0	0.10-0.17	7.4-8.4	Low	0.24			
Bv	0-7	5-18	1.15-1.50	0.6-2.0	0.16-0.22	6.1-7.8	Low	0.28	5	3	2-6
Bruce	7-13	8-22	1.30-1.60	0.6-2.0	0.16-0.24	6.1-7.8	Low	0.28			
	13-25	18-27	1.35-1.70	0.2-0.6	0.20-0.24	6.6-7.8	Low	0.28			
	25-60	8-27	1.35-1.70	0.2-0.6	0.10-0.18	7.4-8.4	Low	0.43			
ChA	0-4	8-15	1.30-1.65	2.0-6.0	0.12-0.18	5.1-6.5	Low	0.24	5	3	2-3
Charlevoix	4-20	10-18	1.35-1.65	2.0-6.0	0.08-0.20	5.1-7.8	Low	0.24			
	20-27	15-35	1.40-1.70	0.6-6.0	0.12-0.18	5.6-7.8	Low	0.32			
	27-60	10-18	1.55-1.70	0.6-6.0	0.06-0.12	7.4-8.4	Low	0.32			
CmB*:											
Charlevoix	0-4	8-15	1.30-1.65	2.0-6.0	0.12-0.18	5.1-6.5	Low	0.24	5	3	2-3
	4-20	10-18	1.35-1.65	2.0-6.0	0.08-0.20	5.1-7.8	Low	0.24			
	20-27	15-35	1.40-1.70	0.6-6.0	0.12-0.18	5.6-7.8	Low	0.32			
	27-60	10-18	1.55-1.70	0.6-6.0	0.06-0.12	7.4-8.4	Low	0.32			
Emmet	0-4	5-15	1.30-1.65	2.0-6.0	0.12-0.15	5.6-6.5	Low	0.24	5	3	1-3
	4-13	10-18	1.40-1.70	2.0-6.0	0.11-0.14	5.6-6.5	Low	0.24			
	13-33	15-25	1.50-1.75	0.6-2.0	0.11-0.18	6.1-7.8	Moderate	0.32			
	33-60	8-18	1.50-1.75	0.6-6.0	0.08-0.14	7.4-8.4	Low	0.28			
CtB	0-8	5-15	1.30-1.50	6.0-20	0.09-0.12	3.6-7.3	Low	0.17	5	2	.5-2
Croswell	8-30	0-10	1.40-1.60	6.0-20	0.06-0.10	4.5-7.3	Low	0.15			
	30-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.1-8.4	Low	0.15			
CuB	0-5	5-15	1.30-1.60	2.0-6.0	0.15-0.20	5.6-7.3	Low	0.24	4	5	1-3
Cunard	5-24	5-18	1.35-1.70	0.6-2.0	0.09-0.19	5.6-7.8	Low	0.24			
	24-29	5-18	1.60-1.70	0.6-2.0	0.08-0.18	7.4-8.4	Low	0.24			
	29	---	---	---	---	---	---	---			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
De--------------	0-2	3-15	1.35-1.50	6.0-20	0.10-0.20	5.6-7.8	Low-----------	0.17	5	2	10-30
Deford	2-60	0-12	1.40-1.60	6.0-20	0.05-0.07	5.6-8.4	Low-----------	0.17			
EaC*, EaD*:											
Emmert-----------	0-2	5-10	1.45-1.55	6.0-20	0.10-0.15	5.1-6.5	Low-----------	0.17	2	8	.5-1
	2-60	1-3	1.55-1.65	>20	0.02-0.04	5.1-7.3	Low-----------	0.10			
Pence------------	0-1	3-11	1.20-1.65	2.0-6.0	0.10-0.18	4.5-6.5	Low-----------	0.24	3	3	1-3
	1-14	2-12	1.35-1.45	2.0-6.0	0.10-0.15	4.5-6.0	Low-----------	0.24			
	14-21	2-10	1.65-1.75	2.0-20	0.05-0.08	4.5-6.5	Low-----------	0.10			
	21-60	0-4	1.35-1.80	>6.0	0.02-0.05	5.1-6.5	Low-----------	0.10			
Sarona-----------	0-4	4-15	1.35-1.65	0.6-2.0	0.10-0.18	4.5-6.5	Low-----------	0.24	5	3	1-3
	4-28	4-12	1.55-1.65	0.6-2.0	0.07-0.17	4.5-6.5	Low-----------	0.24			
	28-38	5-12	1.60-1.70	0.6-2.0	0.06-0.14	4.5-6.5	Low-----------	0.24			
	38-60	4-15	1.60-1.70	0.6-2.0	0.06-0.13	5.1-6.5	Low-----------	0.24			
EmB, EmC, EmD, EmE-------------	0-3	5-15	1.30-1.65	2.0-6.0	0.12-0.15	5.6-6.5	Low-----------	0.24	5	3	1-3
Emmet	3-13	10-18	1.40-1.70	2.0-6.0	0.11-0.14	5.6-6.5	Low-----------	0.24			
	13-33	15-25	1.50-1.75	0.6-2.0	0.11-0.18	6.1-7.8	Moderate-----	0.32			
	33-60	8-18	1.50-1.75	0.6-6.0	0.08-0.14	7.4-8.4	Low-----------	0.28			
EoB, EoC---------	0-7	5-15	1.30-1.55	2.0-6.0	0.07-0.12	5.6-6.5	Low-----------	0.17	5	8	1-3
Emmet	7-13	10-18	1.40-1.70	2.0-6.0	0.11-0.14	5.6-6.5	Low-----------	0.24			
	13-26	15-25	1.60-1.85	0.6-2.0	0.11-0.18	6.1-7.8	Moderate-----	0.32			
	26-60	8-18	1.40-1.65	0.6-6.0	0.08-0.12	7.4-8.4	Low-----------	0.32			
Ey---------------	0-5	10-20	1.30-1.60	2.0-6.0	0.20-0.24	6.1-7.8	Low-----------	0.32	5	5	3-6
Ensley	5-25	10-25	1.30-1.70	0.6-2.0	0.11-0.18	6.6-8.4	Low-----------	0.24			
	25-60	8-18	1.45-1.70	0.6-6.0	0.10-0.14	7.4-8.4	Low-----------	0.20			
FsB, FsC---------	0-2	8-20	1.20-1.35	0.6-2.0	0.22-0.24	3.6-6.5	Low-----------	0.37	5	5	1-2
Fence	2-17	5-18	1.50-1.60	0.2-0.6	0.11-0.22	3.6-6.5	Low-----------	0.37			
	17-39	8-18	1.50-1.60	0.2-0.6	0.17-0.22	3.6-6.5	Low-----------	0.37			
	39-60	5-15	1.50-1.60	0.2-0.6	0.17-0.22	4.5-7.8	Low-----------	0.37			
Fw---------------	0-9	10-22	1.00-1.40	0.6-2.0	0.20-0.22	6.6-7.8	Low-----------	0.28	4	5	5-15
Forada	9-26	8-18	1.30-1.50	2.0-6.0	0.12-0.19	6.6-7.8	Low-----------	0.28			
	26-60	0-5	1.50-1.70	6.0-20	0.02-0.04	7.4-8.4	Low-----------	0.15			
GaA--------------	0-3	10-18	1.40-1.60	0.6-2.0	0.20-0.24	4.5-6.5	Low-----------	0.37	5	5	3-4
Gaastra	3-26	12-25	1.45-1.70	0.2-0.6	0.20-0.22	4.5-7.3	Low-----------	0.37			
	26-60	10-18	1.50-1.70	0.2-0.6	0.20-0.22	5.1-7.3	Low-----------	0.37			
GmB, GmC---------	0-4	5-12	1.35-1.45	0.6-2.0	0.18-0.24	3.6-6.5	Low-----------	0.37	5	5	2-4
Goodman	4-35	8-14	1.45-1.60	0.6-2.0	0.17-0.22	3.6-6.5	Low-----------	0.37			
	35-37	2-12	1.50-1.65	0.6-2.0	0.04-0.16	3.6-6.5	Low-----------	0.24			
	37-60	2-12	1.55-1.75	0.6-2.0	0.04-0.12	5.1-6.5	Low-----------	0.24			
HbB--------------	0-5	18-27	1.50-1.60	0.6-2.0	0.18-0.22	3.6-6.0	Low-----------	0.37	3	6	2-4
Hibbing	5-30	35-60	1.55-1.65	0.06-0.2	0.10-0.16	5.1-7.8	High----------	0.37			
	30-60	35-60	1.55-1.65	0.06-0.2	0.09-0.15	7.4-8.4	High----------	0.37			
IsA--------------	0-9	5-15	1.35-1.70	2.0-6.0	0.10-0.13	5.1-6.5	Low-----------	0.17	5	2	3-7
Iosco	9-24	2-5	1.45-1.60	6.0-20	0.06-0.11	5.1-7.8	Low-----------	0.17			
	24-28	15-25	1.55-1.65	0.6-2.0	0.15-0.19	7.9-8.4	Low-----------	0.32			
	28-60	8-20	1.30-1.70	0.6-2.0	0.10-0.19	7.9-8.4	Low-----------	0.24			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
IxC*:											
Ishpeming-------	0-6	2-15	1.30-1.60	6.0-20	0.09-0.12	4.5-6.5	Low-----------	0.17	4	2	1-2
	6-36	2-15	1.30-1.60	6.0-20	0.05-0.11	4.5-6.5	Low-----------	0.17			
	36	---	---	---	---	---	-------------	----			
Rock outcrop.											
KaB, KaC---------Karlin	0-2	0-12	1.35-1.60	2.0-6.0	0.08-0.12	3.6-6.5	Low-----------	0.17	4	2	.5-2
	2-17	2-15	1.35-1.60	2.0-6.0	0.08-0.16	3.6-6.5	Low-----------	0.17			
	17-30	0-15	1.40-1.65	6.0-20	0.03-0.08	4.5-6.5	Low-----------	0.17			
	30-60	0-10	1.40-1.70	6.0-20	0.03-0.04	5.6-7.3	Low-----------	0.15			
KeB, KeC, KeD----Keweenaw	0-4	2-15	1.35-1.60	2.0-6.0	0.09-0.12	4.5-6.5	Low-----------	0.17	5	2	.5-2
	4-24	2-15	1.45-1.80	2.0-6.0	0.08-0.11	4.5-6.5	Low-----------	0.17			
	24-36	0-15	1.50-1.80	0.6-6.0	0.06-0.14	4.5-6.5	Low-----------	0.17			
	36-60	2-15	1.50-1.70	2.0-6.0	0.04-0.10	5.1-6.5	Low-----------	0.17			
Ls*:											
Loxley----------	0-15	---	0.30-0.40	>6.0	0.35-0.65	<4.5	-------------	----	5	7	70-90
	15-60	---	0.10-0.35	0.2-6.0	0.35-0.45	<4.5	-------------	----			
Dawson----------	0-8	---	0.15-0.30	>6.0	0.55-0.65	3.6-4.4	-------------	----	4	7	65-85
	8-36	---	0.15-0.40	0.2-6.0	0.35-0.45	3.6-4.4	-------------	----			
	36-60	0-10	1.55-1.75	6.0-20	0.03-0.10	4.5-6.5	Low-----------	----			
McB, McC, McD----Mancelona	0-6	0-10	1.35-1.65	2.0-6.0	0.08-0.12	5.1-7.3	Low-----------	0.17	4	2	.5-3
	6-21	2-15	1.30-1.65	6.0-20	0.06-0.12	5.6-7.8	Low-----------	0.17			
	21-32	10-25	1.30-1.65	2.0-6.0	0.06-0.16	6.1-7.8	Low-----------	0.17			
	32-60	0-10	1.45-1.65	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			
MeB--------------Manistee	0-3	3-12	1.35-1.60	6.0-20	0.10-0.12	4.5-7.3	Low-----------	0.17	4	2	2-4
	3-28	2-12	1.35-1.60	6.0-20	0.06-0.10	4.5-7.3	Low-----------	0.17			
	28-36	35-60	1.50-1.70	<0.06	0.08-0.12	5.1-7.3	High----------	0.32			
	36-60	35-60	1.60-1.75	0.06-0.2	0.08-0.16	6.6-8.4	High----------	0.32			
MhB, MhC, MhD----Menahga	0-2	0-8	1.40-1.65	6.0-20	0.07-0.09	4.5-6.5	Low-----------	0.15	5	1	.5-2
	2-25	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low-----------	0.15			
	25-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.3	Low-----------	0.15			
MmB*, MmC*, MmD*:											
Menahga---------	0-2	0-8	1.40-1.65	6.0-20	0.07-0.09	4.5-6.5	Low-----------	0.15	5	1	.5-2
	2-25	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low-----------	0.15			
	25-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.3	Low-----------	0.15			
Mancelona-------	0-6	0-10	1.35-1.65	2.0-6.0	0.08-0.12	5.1-7.3	Low-----------	0.17	4	2	.5-3
	6-21	2-15	1.30-1.65	6.0-20	0.06-0.12	5.6-7.8	Low-----------	0.17			
	21-32	10-25	1.30-1.65	2.0-6.0	0.06-0.16	6.1-7.8	Low-----------	0.17			
	32-60	0-10	1.45-1.65	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			
Menominee-------	0-8	3-7	1.15-1.60	6.0-20	0.10-0.12	4.5-6.5	Low-----------	0.17	5	2	.5-1
	8-36	2-5	1.25-1.60	6.0-20	0.06-0.08	4.5-6.5	Low-----------	0.17			
	36-50	18-35	1.30-1.70	0.6-2.0	0.15-0.20	5.6-8.4	Moderate------	0.32			
	50-60	10-20	1.30-1.70	0.6-2.0	0.11-0.19	5.6-8.4	Low-----------	0.32			
MoB, MoC, MoD----Menominee	0-8	3-7	1.15-1.60	6.0-20	0.10-0.12	4.5-6.5	Low-----------	0.17	5	2	.5-1
	8-36	2-5	1.25-1.60	6.0-20	0.06-0.08	4.5-6.5	Low-----------	0.17			
	36-50	18-35	1.30-1.70	0.6-2.0	0.15-0.20	5.6-8.4	Moderate------	0.32			
	50-60	10-20	1.30-1.70	0.6-2.0	0.11-0.19	5.6-8.4	Low-----------	0.32			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
MrC*:											
Michigamme------	0-2	10-15	1.10-1.60	0.6-2.0	0.10-0.18	3.6-6.5	Low-----------	0.20	4	3	1-3
	2-24	10-15	1.10-1.60	0.6-2.0	0.13-0.24	3.6-6.5	Low-----------	0.20			
	24	---	---	---	---	---	-------------	----			
Rock outcrop.											
MsA--------------	0-8	8-15	1.10-1.40	0.6-2.0	0.12-0.18	3.6-6.5	Low-----------	0.24	5	3	.5-2
Monico	8-26	3-18	1.65-1.75	0.6-2.0	0.09-0.19	3.6-6.5	Low-----------	0.24			
	26-60	2-8	1.70-1.80	0.6-2.0	0.06-0.12	5.1-7.3	Low-----------	0.10			
Mt---------------	0-12	10-15	1.40-1.70	0.6-2.0	0.13-0.22	4.5-7.8	Low-----------	0.24	5	3	2-3
Moquah	12-60	8-18	1.55-1.70	0.2-2.0	0.12-0.22	4.5-7.8	Low-----------	0.24			
NaB, NaC---------	0-2	2-15	1.30-1.60	0.6-2.0	0.12-0.18	5.6-7.3	Low-----------	0.24	3	3	1-3
Nadeau	2-14	2-15	1.30-1.60	0.6-2.0	0.12-0.22	5.6-7.3	Low-----------	0.24			
	14-20	8-18	1.35-1.60	0.6-2.0	0.04-0.09	5.6-7.8	Low-----------	0.17			
	20-60	0-10	1.45-1.65	>20	0.01-0.04	7.4-8.4	Low-----------	0.10			
Nh---------------	0-9	---	0.30-0.40	0.2-6.0	0.35-0.45	6.1-7.8	-------------	----	4	2	40-60
Nahma	9-40	12-18	1.40-1.70	0.6-2.0	0.10-0.19	6.6-8.4	Low-----------	0.24			
	40	---	---	---	---	---	-------------	----			
PaB, PaC, PaD----	0-5	3-10	1.35-1.70	0.6-6.0	0.10-0.15	4.5-6.5	Low-----------	0.24	4	3	.5-2
Padus	5-24	5-18	1.40-1.65	0.6-6.0	0.09-0.22	4.5-6.5	Low-----------	0.24			
	24-27	2-10	1.40-1.65	0.6-6.0	0.05-0.14	4.5-6.5	Low-----------	0.10			
	27-60	0-3	1.55-1.80	>6.0	0.02-0.06	5.1-6.5	Low-----------	0.10			
PkB, PkC---------	0-2	3-11	1.20-1.65	2.0-6.0	0.10-0.18	4.5-6.5	Low-----------	0.24	3	3	1-3
Pence	2-14	2-12	1.35-1.45	2.0-6.0	0.10-0.15	4.5-6.5	Low-----------	0.24			
	14-21	2-10	1.65-1.75	2.0-20	0.05-0.08	4.5-6.5	Low-----------	0.10			
	21-60	0-4	1.35-1.80	>6.0	0.02-0.05	5.1-6.5	Low-----------	0.10			
Pm---------------	0-6	27-40	1.10-1.35	0.2-0.6	0.20-0.24	5.1-7.8	Moderate-----	0.43	3	7	10-15
Pickford	6-20	35-60	1.40-1.65	<0.06	0.09-0.13	5.1-7.8	Moderate-----	0.32			
	20-60	40-60	1.50-1.70	<0.06	0.08-0.12	6.6-8.4	Moderate-----	0.32			
Pn---------------	0-8	2-12	1.00-1.50	2.0-6.0	0.10-0.12	5.6-7.8	Low-----------	0.17	4	2	4-6
Pinconning	8-27	2-12	1.40-1.55	6.0-20	0.06-0.11	6.1-7.8	Low-----------	0.17			
	27-60	35-60	1.50-1.70	<0.2	0.08-0.12	6.6-8.4	High----------	0.32			
Pt*.											
Pits											
Rc---------------	0-7	0-12	0.90-1.60	6.0-20	0.08-0.20	5.6-7.8	Low-----------	0.17	5	2	4-15
Roscommon	7-60	0-10	1.45-1.70	6.0-20	0.05-0.09	5.6-8.4	Low-----------	0.17			
Rm*:											
Roscommon--------	0-7	0-12	0.90-1.60	6.0-20	0.08-0.20	5.6-7.8	Low-----------	0.17	5	2	4-15
	7-60	0-10	1.45-1.70	6.0-20	0.05-0.09	5.6-8.4	Low-----------	0.17			
Rock outcrop.											
RsB--------------	0-2	2-12	1.30-1.55	2.0-6.0	0.10-0.12	4.5-6.0	Low-----------	0.17	5	2	1-2
Rousseau	2-32	0-10	1.30-1.60	2.0-20	0.06-0.11	4.5-6.5	Low-----------	0.15			
	32-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.1-6.5	Low-----------	0.15			
Sa*:											
Saprists.											
Psammaquents.											

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
SbB, SbC, SbD----	0-4	4-15	1.35-1.65	0.6-2.0	0.10-0.18	4.5-6.5	Low-----------	0.24	5	3	1-3
Sarona	4-28	4-12	1.55-1.65	0.6-2.0	0.07-0.17	4.5-6.5	Low-----------	0.24			
	28-38	5-12	1.60-1.70	0.6-2.0	0.06-0.14	4.5-6.5	Low-----------	0.24			
	38-60	4-15	1.60-1.70	0.6-2.0	0.06-0.13	5.1-6.5	Low-----------	0.24			
ScB, ScC---------	0-3	1-5	1.30-1.40	2.0-6.0	0.08-0.12	4.5-6.5	Low-----------	0.17	4	2	.5-1
Sayner	3-25	1-5	1.35-1.45	2.0-6.0	0.03-0.12	4.5-6.5	Low-----------	0.17			
	25-60	0-3	1.55-1.80	>6.0	0.02-0.04	5.1-6.5	Low-----------	0.10			
Sd*:											
Seelyeville-----	0-12	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-8.4	-------------	----	5	2	>25
	12-60	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-8.4	-------------	----			
Markey----------	0-21	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	-------------	----	4	2	55-85
	21-60	0-10	1.40-1.65	6.0-20	0.03-0.08	5.6-8.4	Low-----------	----			
SeA--------------	0-10	15-27	1.30-1.60	0.6-2.0	0.18-0.24	5.6-7.3	Low-----------	0.37	3	5	3-4
Selkirk	10-28	45-60	1.40-1.60	0.06-0.2	0.08-0.13	5.6-7.3	High----------	0.28			
	28-60	45-60	1.40-1.60	0.06-0.2	0.07-0.12	7.4-8.4	High----------	0.28			
SfB, SfC, SfD----	0-2	2-8	1.10-1.35	6.0-20	0.11-0.13	4.5-7.3	Low-----------	0.17	5	2	<1
Shawano	2-26	1-3	1.45-1.70	6.0-20	0.07-0.09	5.1-6.5	Low-----------	0.15			
	26-60	1-3	1.50-1.70	6.0-20	0.05-0.08	5.6-7.8	Low-----------	0.15			
SuB, SuC---------	0-9	10-18	1.30-1.60	2.0-6.0	0.08-0.18	6.1-7.8	Low-----------	0.24	2	3	1-2
Summerville	9-17	10-25	1.35-1.65	0.6-2.0	0.10-0.16	6.1-8.4	Low-----------	0.24			
	17	---	---	---	---	---	-------------	----			
Ud.											
Udorthents											
Ur*.											
Urban land											
WaA--------------	0-2	0-10	1.35-1.50	6.0-20	0.10-0.12	4.5-6.5	Low-----------	0.17	5	2	2-4
Wainola	2-18	2-12	1.35-1.45	6.0-20	0.06-0.11	4.5-7.3	Low-----------	0.15			
	18-60	0-10	1.25-1.50	6.0-20	0.05-0.07	5.1-7.3	Low-----------	0.15			
WrA--------------	0-2	5-15	1.35-1.55	0.6-2.0	0.10-0.18	4.5-6.5	Low-----------	0.24	4	3	1-3
Worcester	2-24	8-18	1.40-1.70	0.6-2.0	0.09-0.22	4.5-6.5	Low-----------	0.32			
	24-30	8-18	1.40-1.70	0.6-2.0	0.06-0.19	4.5-6.5	Low-----------	0.32			
	30-60	0-3	1.30-2.00	>6.0	0.02-0.07	5.1-6.5	Low-----------	0.15			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "frequent," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hard-ness	Total subsi-dence	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In		In			
AdA------------- Allendale	B	None---------	---	---	1.0-2.0	Apparent	Nov-May	>60	---	---	Moderate	High-----	Moderate.
AkC, AkE-------- Alpena	A	None---------	---	---	>6.0	---	---	>60	---	---	Low------	Low------	Low.
Ar-------------- Arnheim	D	Frequent----	Brief-----	Nov-May	0-1.0	Apparent	Nov-May	>60	---	---	High-----	High-----	Moderate.
AuA------------- Au Gres	B	None---------	---	---	0.5-1.5	Apparent	Nov-May	>60	---	---	Moderate	Low------	Moderate.
BaA------------- Banat	B	None---------	---	---	0.5-1.5	Apparent	Oct-May	>60	---	---	High-----	Low------	Low.
BnA------------- Bonduel	C	None---------	---	---	1.0-3.0	Apparent	Sep-Jun	20-40	Hard	---	High-----	Moderate	Low.
Bs-------------- Brevort	B/D	None---------	---	---	+1-1.0	Apparent	Nov-May	>60	---	---	Moderate	High-----	Low.
Bv-------------- Bruce	B/D	None---------	---	---	+1-1.0	Apparent	Nov-May	>60	---	---	High-----	High-----	Low.
ChA------------- Charlevoix	B	None---------	---	---	1.0-2.0	Apparent	Nov-May	>60	---	---	High-----	Moderate	Moderate.
CmB*:													
Charlevoix-----	B	None---------	---	---	1.0-2.0	Apparent	Nov-May	>60	---	---	High-----	Moderate	Moderate.
Emmet----------	B	None---------	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	Moderate.
CtB------------- Croswell	A	None---------	---	---	2.0-4.0	Apparent	Nov-May	>60	---	---	Low------	Low------	Moderate.
CuB------------- Cunard	B	None---------	---	---	>6.0	---	---	20-40	Hard	---	Moderate	Low------	Low.
De-------------- Deford	A/D	None---------	---	---	+1-1.0	Apparent	Oct-May	>60	---	---	Moderate	Low------	Moderate.
EaC*, EaD*:													
Emmert---------	A	None---------	---	---	>6.0	---	---	>60	---	---	Low------	Low------	Moderate.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hard-ness	Total subsi-dence	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In		In			
EaC*, EaD*:													
Pence----------	B	None--------	---	---	>6.0	---	---	>60	---	---	Low------	Low------	Moderate.
Sarona---------	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	High.
EmB, EmC, EmD, EmE, EoB, EoC-- Emmet	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	Moderate.
Ey-------------- Ensley	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jun	>60	---	---	High-----	High-----	Low.
FsB, FsC-------- Fence	B	None--------	---	---	>6.0	---	---	>60	---	---	High-----	Low------	High.
Fw-------------- Forada	B/D	None--------	---	---	+1-1.0	Apparent	Jan-Dec	>60	---	---	High-----	Low------	Low.
GaA------------- Gaastra	C	None--------	---	---	1.0-2.0	Perched	Nov-May	>60	---	---	High-----	Moderate	Moderate.
GmB, GmC-------- Goodman	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	High.
HbB------------- Hibbing	C	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	High-----	Moderate.
IsA------------- Iosco	B	None--------	---	---	1.0-3.0	Apparent	Nov-May	>60	---	---	High-----	High-----	Low.
IxC*:													
Ishpeming------	A	None--------	---	---	>6.0	---	---	20-40	Hard	---	Low------	Low------	High.
Rock outcrop.													
KaB, KaC-------- Karlin	A	None--------	---	---	>6.0	---	---	>60	---	---	Low------	Low------	High.
KeB, KeC, KeD--- Keweenaw	A	None--------	---	---	>6.0	---	---	>60	---	---	Low------	Low------	Moderate.
Ls*:													
Loxley---------	A/D	None--------	---	---	+1-1.0	Apparent	Nov-May	>60	---	50-55	High-----	High-----	High.
Dawson---------	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	30-36	High-----	High-----	High.
McB, McC, McD--- Mancelona	A	None--------	---	---	>6.0	---	---	>60	---	---	Low------	Low------	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hard-ness	Total subsi-dence	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In		In			
MeB-------------- Manistee	A	None---------	---	---	>6.0	---	---	>60	---	---	Low-------	High-----	Moderate.
MhB, MhC, MhD--- Menahga	A	None---------	---	---	>6.0	---	---	>60	---	---	Low-------	Low-------	Moderate.
MmB*, MmC*, MmD*:													
Menahga--------	A	None---------	---	---	>6.0	---	---	>60	---	---	Low-------	Low-------	Moderate.
Mancelona------	A	None---------	---	---	>6.0	---	---	>60	---	---	Low-------	Low-------	Low.
Menominee------	A	None---------	---	---	>6.0	---	---	>60	---	---	Low-------	Low-------	Moderate.
MoB, MoC, MoD--- Menominee	A	None---------	---	---	>6.0	---	---	>60	---	---	Low-------	Low-------	Moderate.
MrC*:													
Michigamme------	C	None---------	---	---	>6.0	---	---	20-40	Hard	---	Moderate	Low-------	High.
Rock outcrop.													
MsA-------------- Monico	C	None---------	---	---	1.0-3.0	Perched	Nov-May	>60	---	---	High------	Moderate	High.
Mt--------------- Moquah	B	Occasional	Brief------	Sep-Jun	3.0-6.0	Apparent	Nov-May	>60	---	---	Moderate	Moderate	Moderate.
NaB, NaC--------- Nadeau	B	None---------	---	---	>6.0	---	---	>60	---	---	Moderate	Low-------	Low.
Nh--------------- Nahma	B/D	None---------	---	---	+1-1.0	Apparent	Nov-Jun	20-40	Hard	---	High------	High------	Low.
PaB, PaC, PaD--- Padus	B	None---------	---	---	>6.0	---	---	>60	---	---	Moderate	Low-------	High.
PkB, PkC--------- Pence	B	None---------	---	---	>6.0	---	---	>60	---	---	Low-------	Low-------	Moderate.
Pm--------------- Pickford	D	None---------	---	---	+1-1.0	Perched	Nov-Jun	>60	---	---	Moderate	High------	Low.
Pn--------------- Pinconning	B/D	None---------	---	---	+1-1.0	Apparent	Oct-May	>60	---	---	Moderate	High------	Moderate.
Pt*. Pits													

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Total subsidence	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In		In			
Rc-------------- Roscommon	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	---	Moderate	High-----	Low.
Rm*: Roscommon------	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	---	Moderate	High-----	Low.
Rock outcrop.													
RsB------------- Rousseau	A	None--------	---	---	2.5-6.0	Apparent	Feb-May	>60	---	---	Low------	Low------	Moderate.
Sa*: Saprists.													
Psammaquents.													
SbB, SbC, SbD--- Sarona	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	Low------	High.
ScB, ScC-------- Sayner	A	None--------	---	---	>6.0	---	---	>60	---	---	Low------	Low------	Moderate.
Sd*: Seelyeville----	A/D	None--------	---	---	+2-2.0	Apparent	Jan-Dec	>60	---	50-55	High-----	High-----	Moderate.
Markey---------	A/D	None--------	---	---	+1-1.0	Apparent	Nov-Jun	>60	---	25-30	High-----	High-----	Low.
SeA------------- Selkirk	C	None--------	---	---	0.5-1.5	Apparent	Nov-May	>60	---	---	High-----	High-----	Low.
SfB, SfC, SfD--- Shawano	A	None--------	---	---	>6.0	---	---	>60	---	---	Low------	Low------	High.
SuB, SuC-------- Summerville	D	None--------	---	---	>6.0	---	---	10-20	Hard	---	Moderate	Low------	Low.
Ud. Udorthents													
Ur*. Urban land													
WaA------------- Wainola	B	None--------	---	---	0.5-1.5	Apparent	Nov-May	>60	---	---	Moderate	Low------	Moderate.
WrA------------- Worcester	C	None--------	---	---	1.0-3.0	Apparent	Nov-May	>60	---	---	High-----	High-----	High.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--ENGINEERING INDEX TEST DATA

(Dashes indicate that data were not available. MAX means maximum dry density; OPT, optimum moisture; LL, liquid limit; PI, plasticity index; UN, Unified; and NP, nonplastic)

Soil name and location	Parent material	Report number	Depth	Moisture density: MAX	Moisture density: OPT	Percentage passing sieve*--: No. 4	No. 10	No. 40	No. 200	Percentage smaller than*--: 0.05 mm	0.02 mm	0.005 mm	0.002 mm	LL	PI	Classification: AASHTO	Classification: UN
			In	Lb/ft^3	Pct									Pct			
Bonduel loam:	Loamy and silty deposits.	S77WI-075-															
SW1/4SE1/4 sec. 17, T. 30 N., R. 22 E.		4-1	8-15	---	---	95	92	86	60	54	39	21	16	27.0	9.8	A-4(5)	CL
		4-2	20-28	---	---	95	93	88	67	63	49	20	10	16.7	NP	A-4(6)	ML
Charlevoix fine sandy loam:	Loamy till.	S76WI-075-															
NE1/4NE1/4 sec. 33, T. 30 N., R. 22 E.		2-1	15-21	---	---	100	100	95	53	46	33	20	15	23.5	7.4	A-4(4)	CL
		2-2	24-60	---	---	88	82	74	38	31	20	10	6	---	NP	A-4(1)	SM-SC
Cunard loam:	Loamy till.	S77WI-075-															
NE1/4NE1/4 sec. 30, T. 31 N., R. 22 E.		2-1	11-22	---	---	92	90	79	36	31	22	12	8	20.7	NP	A-4(0)	SM
		2-2	24-29	---	---	80	75	65	29	24	15	7	4	13.8	NP	A-2-4(0)	SM
Emmet fine sandy loam:	Predominantly loamy till.	S76WI-075-															
NE1/4NE1/4 sec. 9, T. 32 N., R. 20 E.		4-1	18-26	---	---	96	94	80	34	32	27	22	19	25.4	11.8	A-2-6(0)	CL
		4-2	33-60	129.3	8.4	93	91	77	22	19	13	7	4	---	NP	A-2-4(0)	SM-SC
Emmet fine sandy loam:	Predominantly loamy till.	S75WI-075-															
NW1/4SW1/4 sec. 2, T. 37 N., R. 21 E.		3-1	18-24	---	---	98	94	85	40	36	31	23	18	21.4	7.6	A-4(1)	SC
		3-2	41-60	---	---	93	90	80	44	40	32	20	12	16.6	5.0	A-4(2)	SM-SC
Fence silt loam:	Silty and loamy lacustrine deposits.	S78WI-075-															
NW1/4NW1/4 sec. 2, T. 37 N., R. 18 E.		2-1	26-29	---	---	100	100	100	98	91	58	15	10	23.7	NP	A-4(8)	ML
		2-1	36-60	101.0	18.6	100	100	100	99	95	64	10	6	25.3	NP	A-4(8)	ML
Goodman silt loam:	Silty eolian deposits and loamy or sandy till.	S75WI-075-															
NW1/4SW1/4 sec. 34, T. 37 N., R. 19 E.		2-1	16-28	---	---	98	98	93	69	56	18	6	3	---	NP	A-4(7)	ML
		2-2	40-60	130.1	7.5	94	91	79	29	24	14	6	4	---	NP	A-2-4(0)	SM

See footnote at end of table.

TABLE 19.--ENGINEERING INDEX TEST DATA--Continued

Soil name and location	Parent material	Report number	Depth	Moisture density: MAX	Moisture density: OPT	Percentage passing sieve*--: No. 4	No. 10	No. 40	No. 200	Percentage smaller than*--: 0.05 mm	0.02 mm	0.005 mm	0.002 mm	LL	PI	Classification: AASHTO	Classification: UN
			In	Lb/ft^3	Pct									Pct			
Goodman silt loam:	Silty eolian	S75WI-075-															
SW1/4SE1/4	deposits and	1-1	11-17	---	---	100	100	97	83	73	36	12	6	---	NP	A-4(8)	ML
sec. 16, T. 37 N.,	loamy or	1-2	34-60	130.8	7.9	78	72	56	19	16	10	5	3	---	NP	A-2-4(0)	SM
R. 17 E.	sandy till.																
Iosco loamy fine																	
sand:	Sandy deposits	S74WI-075-															
SW1/4SW1/4	and	4-1	28-33	---	---	97	95	89	61	56	47	33	25	28.0	13.6	A-6(7)	CL
sec. 29, T. 30 N.,	calcareous	4-2	33-60	127.7	8.9	85	80	71	29	23	15	9	5	---	NP	A-2-4(0)	SM
R. 18 E.	loamy till.																
Pence sandy loam:	Loamy and	S82WI-075-															
NW1/4SE1/4	sandy	3-1	8-14	---	---	100	100	76	52	43	19	7	4	---	NP	A-4(3)	ML
sec. 33, T. 37 N.,	deposits	3-2	20-60	---	---	92	81	46	4	4	3	2	1	---	NP	A-1-b(0)	SP
R. 20 E.	underlain by																
	noncalcareous																
	sand or sand																
	and gravel.																
Sarona fine sandy																	
loam:	Loamy deposits	S82WI-075-															
SW1/4SE1/4	and the	1-1	9-28	---	---	100	100	91	49	41	21	8	4	---	NP	A-4(3)	SM
sec. 26, T. 37 N.,	underlying	1-2	31-34	---	---	100	100	86	36	32	22	13	9	---	NP	A-4(0)	SM
R. 17 E.	loamy or	1-3	38-60	---	---	92	88	71	23	21	15	9	6	---	NP	A-2-4(0)	SM
	sandy till.																
Shawano loamy fine																	
sand:	Sandy deposits	S84WI-075-															
SE1/4SE1/4	that are	2-1	4-11	---	---	100	100	100	9	6	5	3	2	---	NP	A-3(0)	SP-SM
sec. 29, T. 30 N.,	predominantly	2-2	11-26	---	---	100	100	100	6	5	4	3	2	---	NP	A-3(0)	SP-SM
R. 23 E.	fine sand in	2-3	26-60	---	---	100	100	100	6	3	2	2	1	---	NP	A-3(0)	SP-SM
	size.																

* Mechanical analysis according to AASHTO designation T88-57 (1). Results from this procedure can differ somewhat from the results obtained by the soil survey of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by hydrometer method and the various grain-size fractions are calculated on the basis of all material up to and including that 3 inches in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from the calculation of grain-size fractions. The mechanical analysis data given in this table are not suitable for use in naming textural classes of soils.

TABLE 20.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Allendale	Sandy over clayey, mixed, frigid Alfic Haplaquods
*Alpena	Sandy-skeletal, mixed Udorthentic Haploborolls
Arnheim	Coarse-loamy, mixed, nonacid, frigid Typic Fluvaquents
Au Gres	Sandy, mixed, frigid Entic Haplaquods
Banat	Loamy-skeletal, mixed, frigid Aeric Ochraqualfs
Bonduel	Fine-loamy, mixed Aquic Eutroboralfs
Brevort	Sandy over loamy, mixed, nonacid, frigid Mollic Haplaquents
*Bruce	Fine-loamy, mixed, nonacid, frigid Mollic Haplaquepts
Charlevoix	Coarse-loamy, mixed, frigid Alfic Haplaquods
Croswell	Sandy, mixed, frigid Entic Haplorthods
Cunard	Coarse-loamy, mixed Typic Eutroboralfs
Dawson	Sandy or sandy-skeletal, mixed, dysic Terric Borosaprists
Deford	Mixed, frigid Typic Psammaquents
Emmert	Sandy-skeletal, mixed, frigid Typic Udorthents
Emmet	Coarse-loamy, mixed Typic Eutroboralfs
Ensley	Coarse-loamy, mixed, nonacid, frigid Aeric Haplaquepts
Fence	Coarse-silty, mixed, frigid Alfic Haplorthods
Forada	Coarse-loamy, mixed, frigid Typic Haplaquolls
Gaastra	Coarse-loamy, mixed, frigid Alfic Haplaquods
Goodman	Coarse-loamy, mixed, frigid Alfic Haplorthods
Hibbing	Fine, mixed Typic Eutroboralfs
Iosco	Sandy over loamy, mixed, frigid Alfic Haplaquods
Ishpeming	Sandy, mixed, frigid Entic Haplorthods
Karlin	Sandy, mixed, frigid Entic Haplorthods
Keweenaw	Sandy, mixed, frigid Alfic Haplorthods
Loxley	Dysic Typic Borosaprists
Mancelona	Sandy, mixed, frigid Alfic Haplorthods
Manistee	Sandy over clayey, mixed, frigid Alfic Haplorthods
Markey	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Menahga	Mixed, frigid Typic Udipsamments
Menominee	Sandy over loamy, mixed, frigid Alfic Haplorthods
Michigamme	Coarse-loamy, mixed, frigid Typic Haplorthods
Monico	Coarse-loamy, mixed, frigid Entic Haplaquods
Moquah	Coarse-loamy, mixed, nonacid, frigid Typic Udifluvents
Nadeau	Coarse-loamy, mixed Typic Eutroboralfs
Nahma	Coarse-loamy, mixed, nonacid, frigid Histic Humaquepts
Padus	Coarse-loamy, mixed, frigid Alfic Haplorthods
Pence	Sandy, mixed, frigid Entic Haplorthods
*Pickford	Fine, mixed, nonacid, frigid Typic Haplaquepts
Pinconning	Sandy over clayey, mixed, nonacid, frigid Mollic Haplaquents
Psammaquents	Mixed, frigid Typic Psammaquents
Roscommon	Mixed, frigid Mollic Psammaquents
Rousseau	Sandy, mixed, frigid Entic Haplorthods
Saprists	Euic Borosaprists
Sarona	Coarse-loamy, mixed, frigid Alfic Haplorthods
Sayner	Sandy, mixed, frigid Entic Haplorthods
Seelyeville	Euic Typic Borosaprists
Selkirk	Fine, illitic Aquic Eutroboralfs
Shawano	Mixed, frigid Typic Udipsamments
*Summerville	Loamy, mixed, frigid Lithic Eutrochrepts
Udorthents	Loamy, mixed, frigid Typic Udorthents
Wainola	Sandy, mixed, frigid Entic Haplaquods
*Worcester	Coarse-loamy, mixed, frigid Aqualfic Haplorthods

*U.S. G.P.O. 1991-281-364:20058

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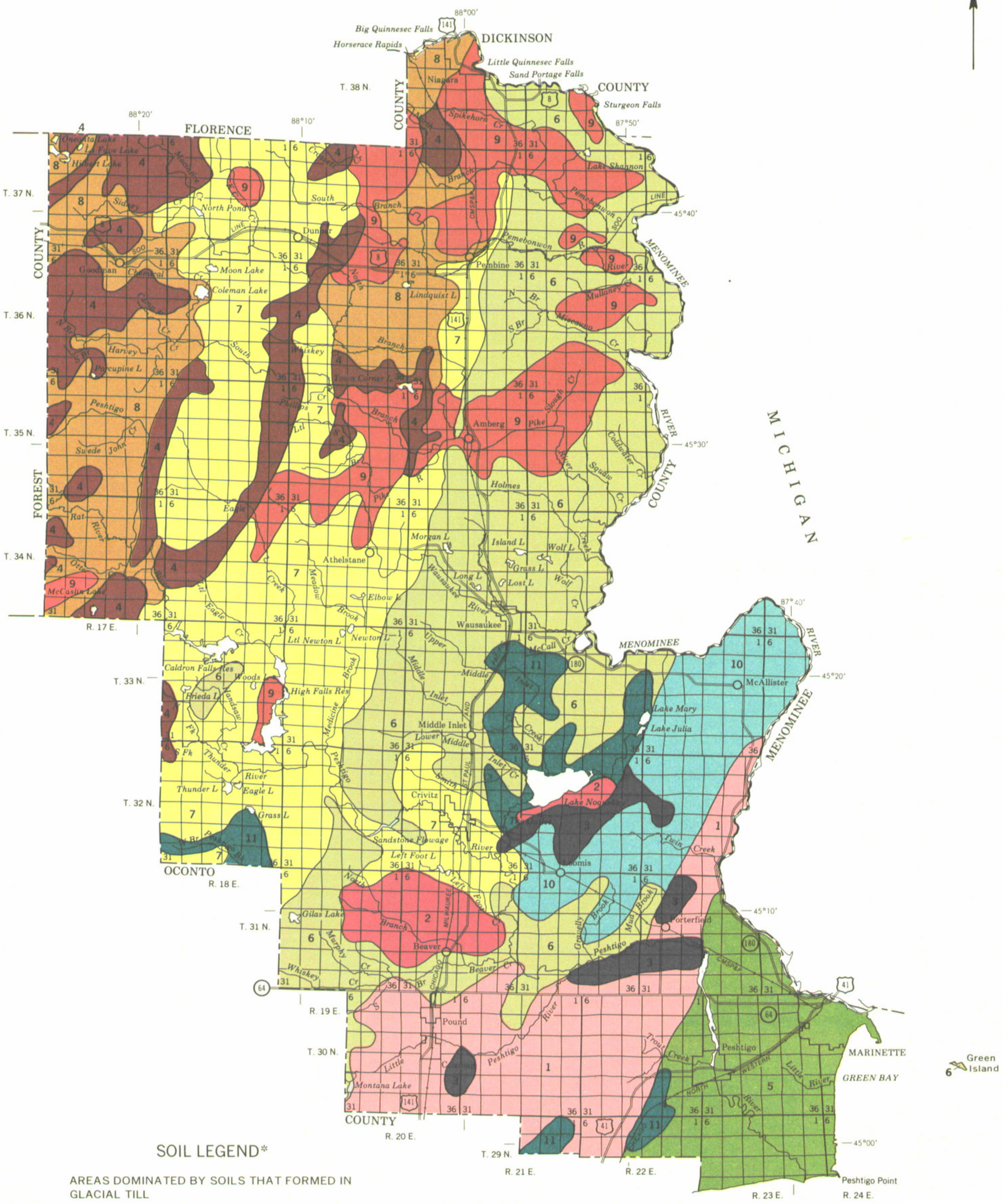
Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



SOIL LEGEND*

AREAS DOMINATED BY SOILS THAT FORMED IN GLACIAL TILL

1 — Emmet-Charlevoix association: Deep, nearly level to steep, well drained and somewhat poorly drained, loamy soils on moraines and drumlins

2 — Menominee-Emmet association: Deep, nearly level to steep, well drained, sandy and loamy soils on outwash plains, moraines, and drumlins

3 — Cunard-Emmet association: Moderately deep and deep, nearly level to steep, well drained, loamy soils on moraines and drumlins

4 — Sarona-Keweenaw association: Deep, nearly level to steep, well drained, loamy and sandy soils on moraines

AREAS DOMINATED BY SOILS THAT FORMED IN GLACIAL OUTWASH AND TILL

5 — Wainola-Deford association: Deep, nearly level and gently sloping, somewhat poorly drained to very poorly drained, sandy and mucky soils in glacial lake basins

6 — Mancelona-Emmet-Menahga association: Deep, nearly level to steep, well drained to excessively drained, sandy and loamy soils primarily on end moraines

7 — Menahga association: Deep, nearly level to steep, excessively drained, sandy soils on moraines, outwash plains, and stream terraces

8 — Pence-Padus association: Deep, nearly level to very steep, well drained, loamy soils on outwash plains, stream terraces, moraines, kames, and eskers

9 — Ishpeming-Michigamme-Rock outcrop association: Moderately deep, gently sloping to moderately steep, somewhat excessively drained and well drained, sandy and loamy soils, and rock outcrop, on outwash plains and moraines

AREAS DOMINATED BY ORGANIC SOILS

10 — Seelyeville-Markey-Emmet association: Deep, nearly level to steep, very poorly drained and well drained, mucky and loamy soils in glacial lake basins, on stream terraces, outwash plains, and moraines, or on upland moraines and drumlins

11 — Seelyeville-Markey association: Deep, nearly level, very poorly drained, mucky soils in glacial lake basins and on stream terraces, outwash plains, and moraines

*Texture terms in the descriptive headings refer to the surface layer of the major soils in the associations.

Compiled 1988

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
THE RESEARCH DIVISION OF THE COLLEGE OF AGRICULTURAL AND LIFE SCIENCES
UNIVERSITY OF WISCONSIN

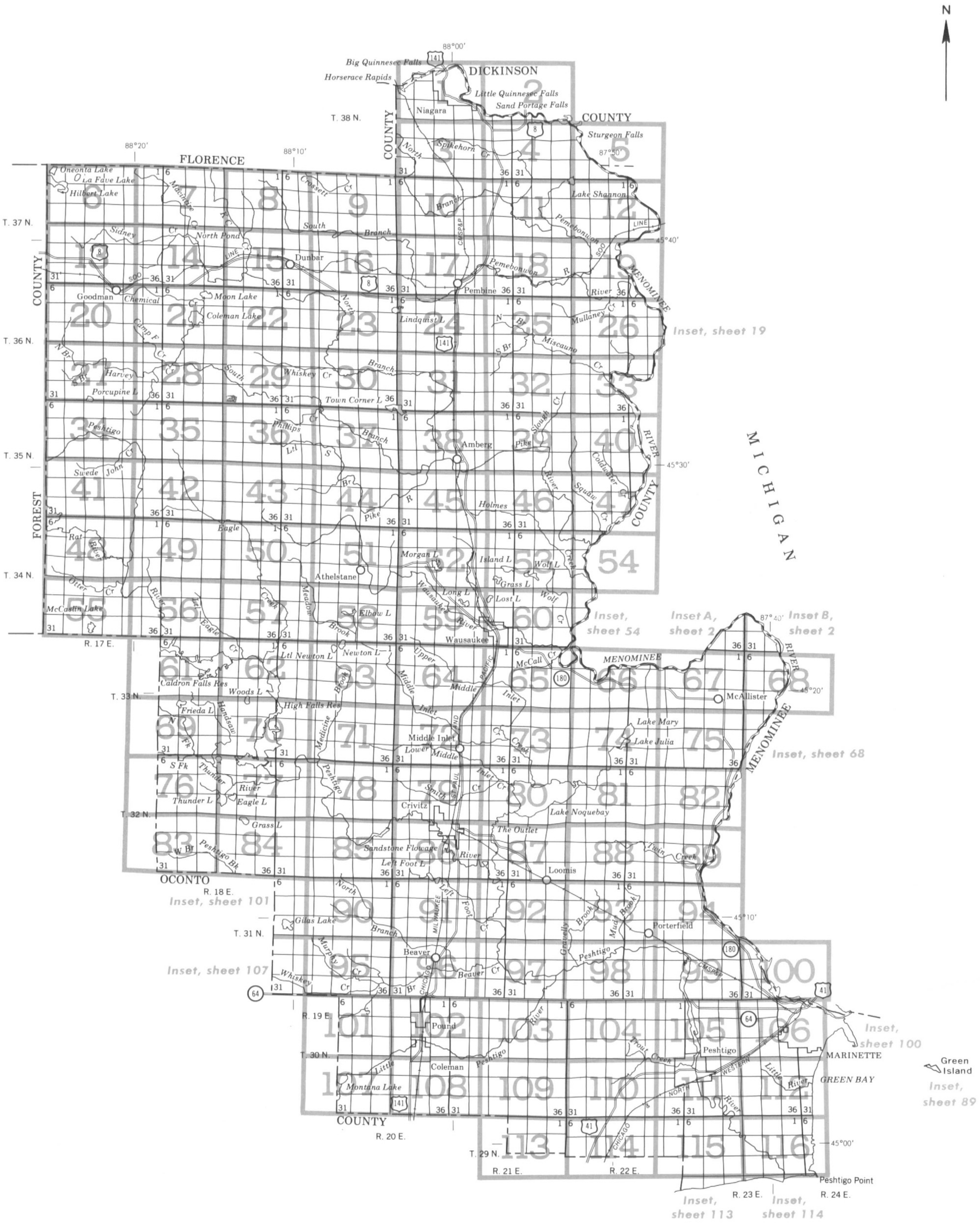
GENERAL SOIL MAP

MARINETTE COUNTY, WISCONSIN

Scale 1:316,800

1 0 1 2 3 4 5 Miles

1 0 5 10 Km



Original text from each individual map sheet read:
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS
MARINETTE COUNTY, WISCONSIN

Scale 1:316,800
1 0 1 2 3 4 5 Miles
1 0 5 10 Km

SOIL LEGEND

Map symbols consist of a combination of letters. The first capital letter is the initial one of the soil name. The lowercase letter that follows separates map units having names that begin with the same letter, except that it does not separate sloping phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas.

SYMBOL	NAME
AdA	Allendale loamy sand, 0 to 3 percent slopes
AkC	Alpena gravelly sandy loam, 6 to 12 percent slopes
AkE	Alpena gravelly sandy loam, 12 to 35 percent slopes
Ar	Arnheim silt loam, 0 to 1 percent slopes
AuA	Au Gres loamy sand, 0 to 3 percent slopes
BaA	Banat sandy loam, 0 to 3 percent slopes
BnA	Bonduel loam, 0 to 3 percent slopes
Bs	Brevort muck, 0 to 2 percent slopes
Bv	Bruce fine sandy loam, 0 to 2 percent slopes
ChA	Charlevoix fine sandy loam, 0 to 3 percent slopes
CmB	Charlevoix-Emmet fine sandy loams, 1 to 6 percent slopes
CtB	Croswell loamy sand, 1 to 6 percent slopes
CuB	Cunard loam, 1 to 6 percent slopes
De	Deford mucky fine sand, 0 to 2 percent slopes
EaC	Emmert-Pence-Sarona complex, 6 to 15 percent slopes
EaD	Emmert-Pence-Sarona complex, 15 to 35 percent slopes
EmB	Emmet fine sandy loam, 1 to 6 percent slopes
EmC	Emmet fine sandy loam, 6 to 12 percent slopes
EmD	Emmet fine sandy loam, 12 to 20 percent slopes
EmE	Emmet fine sandy loam, 20 to 30 percent slopes
EoB	Emmet cobbly fine sandy loam, 2 to 6 percent slopes
EoC	Emmet cobbly fine sandy loam, 6 to 12 percent slopes
Ey	Ensley loam, 0 to 2 percent slopes
FsB	Fence silt loam, 2 to 6 percent slopes
FsC	Fence silt loam, 6 to 15 percent slopes
Fw	Forada mucky loam, 0 to 1 percent slopes
GaA	Gaastra silt loam, 0 to 3 percent slopes
GmB	Goodman silt loam, 2 to 6 percent slopes
GmC	Goodman silt loam, 6 to 15 percent slopes
HbB	Hibbing silt loam, 1 to 6 percent slopes
IsA	Iosco loamy fine sand, 0 to 3 percent slopes
IxC	Ishpeming-Rock outcrop complex, 4 to 15 percent slopes
KaB	Karlin loamy fine sand, 2 to 6 percent slopes
KaC	Karlin loamy fine sand, 6 to 15 percent slopes
KeB	Keweenaw loamy sand, 1 to 6 percent slopes
KeC	Keweenaw loamy sand, 6 to 15 percent slopes
KeD	Keweenaw loamy sand, 15 to 25 percent slopes
Ls	Loxley and Dawson peats, 0 to 1 percent slopes
McB	Mancelona loamy sand, 0 to 6 percent slopes
McC	Mancelona loamy sand, 6 to 12 percent slopes
McD	Mancelona loamy sand, 12 to 20 percent slopes
MeB	Manistee loamy sand, 2 to 6 percent slopes
MhB	Menahga sand, 0 to 6 percent slopes
MhC	Menahga sand, 6 to 15 percent slopes
MhD	Menahga sand, 15 to 25 percent slopes
MmB	Menahga-Mancelona-Menominee complex, 2 to 6 percent slopes
MmC	Menahga-Mancelona-Menominee complex, 6 to 15 percent slopes
MmD	Menahga-Mancelona-Menominee complex, 15 to 25 percent slopes
MoB	Menominee loamy sand, 2 to 6 percent slopes
MoC	Menominee loamy sand, 6 to 12 percent slopes
MoD	Menominee loamy sand, 12 to 20 percent slopes
MrC	Michigamme-Rock outcrop complex, 4 to 15 percent slopes
MsA	Monico fine sandy loam, 0 to 3 percent slopes
Mt	Moquah fine sandy loam, 0 to 2 percent slopes
NaB	Nadeau fine sandy loam, 2 to 6 percent slopes
NaC	Nadeau fine sandy loam, 6 to 12 percent slopes
Nh	Nahma muck, 0 to 2 percent slopes
PaB	Padus fine sandy loam, 1 to 6 percent slopes
PaC	Padus fine sandy loam, 6 to 15 percent slopes
PaD	Padus fine sandy loam, 15 to 25 percent slopes
PkB	Pence sandy loam, 1 to 6 percent slopes
PkC	Pence sandy loam, 6 to 15 percent slopes
Pm	Pickford mucky silty clay loam, 0 to 2 percent slopes
Pn	Pinconning loamy sand, 0 to 2 percent slopes
Pt	Pits
Rc	Roscommon mucky loamy sand, 0 to 2 percent slopes
Rm	Roscommon-Rock outcrop complex, 0 to 2 percent slopes
RsB	Rousseau loamy fine sand, 1 to 6 percent slopes
Sa	Saprists and Psammaquents, ponded
SbB	Sarona fine sandy loam, 2 to 6 percent slopes
SbC	Sarona fine sandy loam, 6 to 15 percent slopes
SbD	Sarona fine sandy loam, 15 to 25 percent slopes
ScB	Sayner loamy sand, 1 to 6 percent slopes
ScC	Sayner loamy sand, 6 to 15 percent slopes
Sd	Seelyeville and Markey mucks, 0 to 1 percent slopes
SeA	Selkirk silt loam, 0 to 3 percent slopes
SfB	Shawano loamy fine sand, 2 to 6 percent slopes
SfC	Shawano loamy fine sand, 6 to 12 percent slopes
SfD	Shawano loamy fine sand, 12 to 30 percent slopes
SuB	Summerville fine sandy loam, 1 to 6 percent slopes
SuC	Summerville fine sandy loam, 6 to 12 percent slopes
Ud	Udorthents, loamy, nearly level
Ur	Urban land
WaA	Wainola loamy fine sand, 0 to 3 percent slopes
WrA	Worcester fine sandy loam, 0 to 3 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County
- Field sheet matchline & neatline

AD HOC BOUNDARY

- Small airport, airfield, park, or cemetery

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads

ROAD EMBLEMS & DESIGNATIONS

- Federal — 141
- State — 64
- County — N

RAILROAD

DAMS

- Large (to scale)
- Medium or small — water, w

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house
- Church
- School

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water, w
- Intermittent — int, i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — FsB, GmC

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

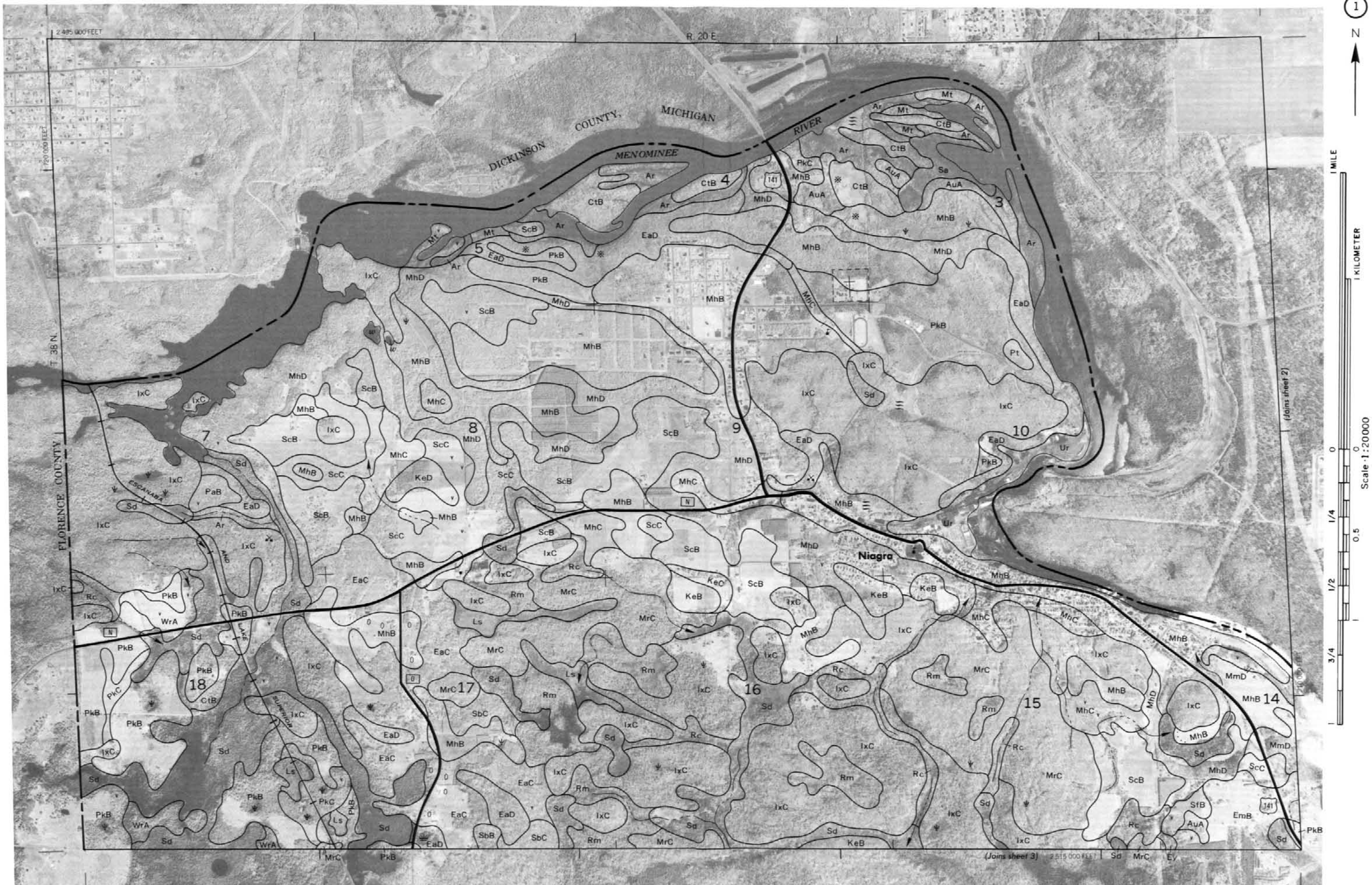
SHORT STEEP SLOPE

DEPRESSION OR SINK

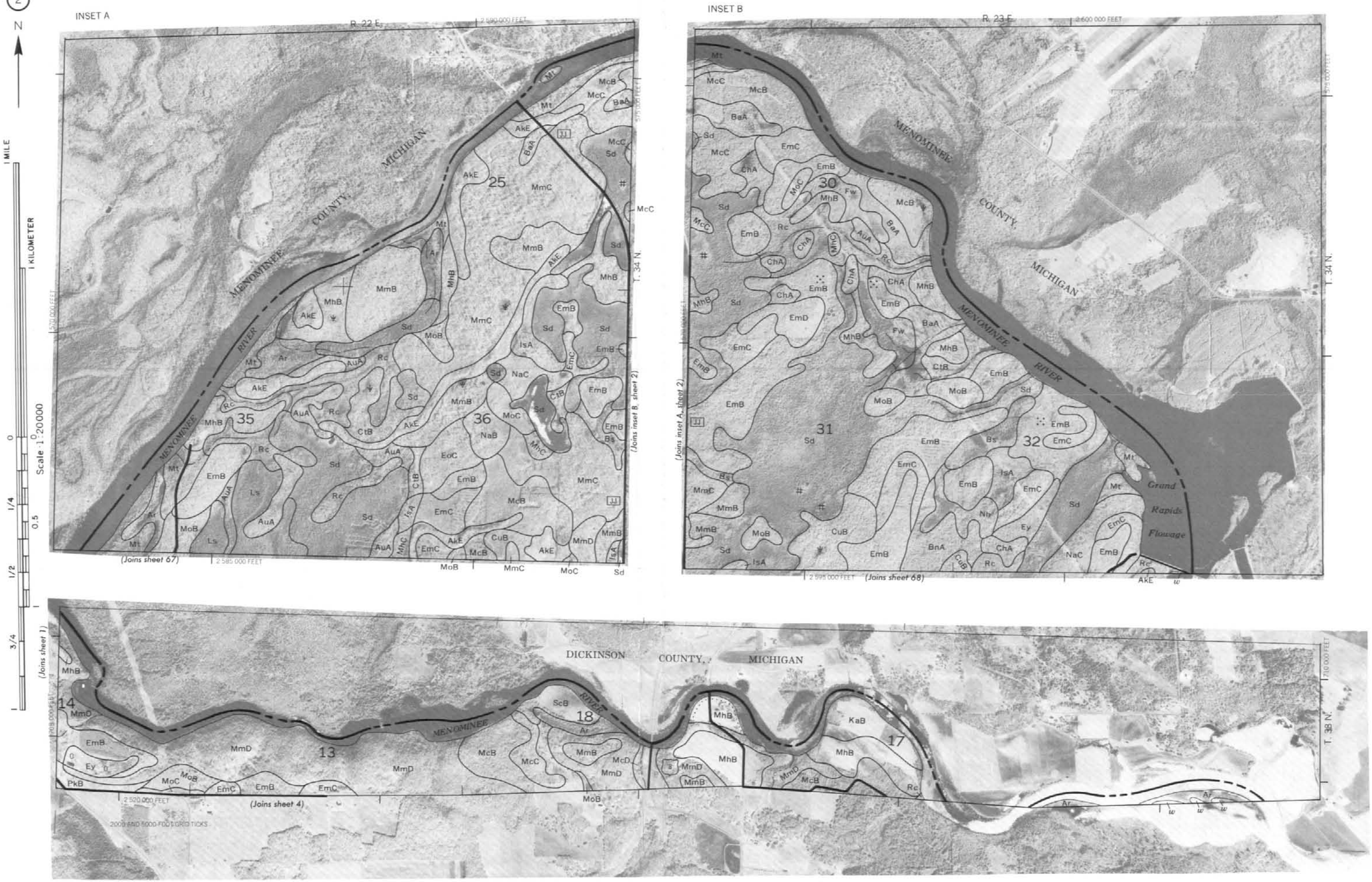
MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Dumps and other similar non soil areas
- Rock outcrop
- Sandy spot
- Severely eroded spot
- Stony spot
- Sand pit
- Island of mineral soil (1-5 acres)

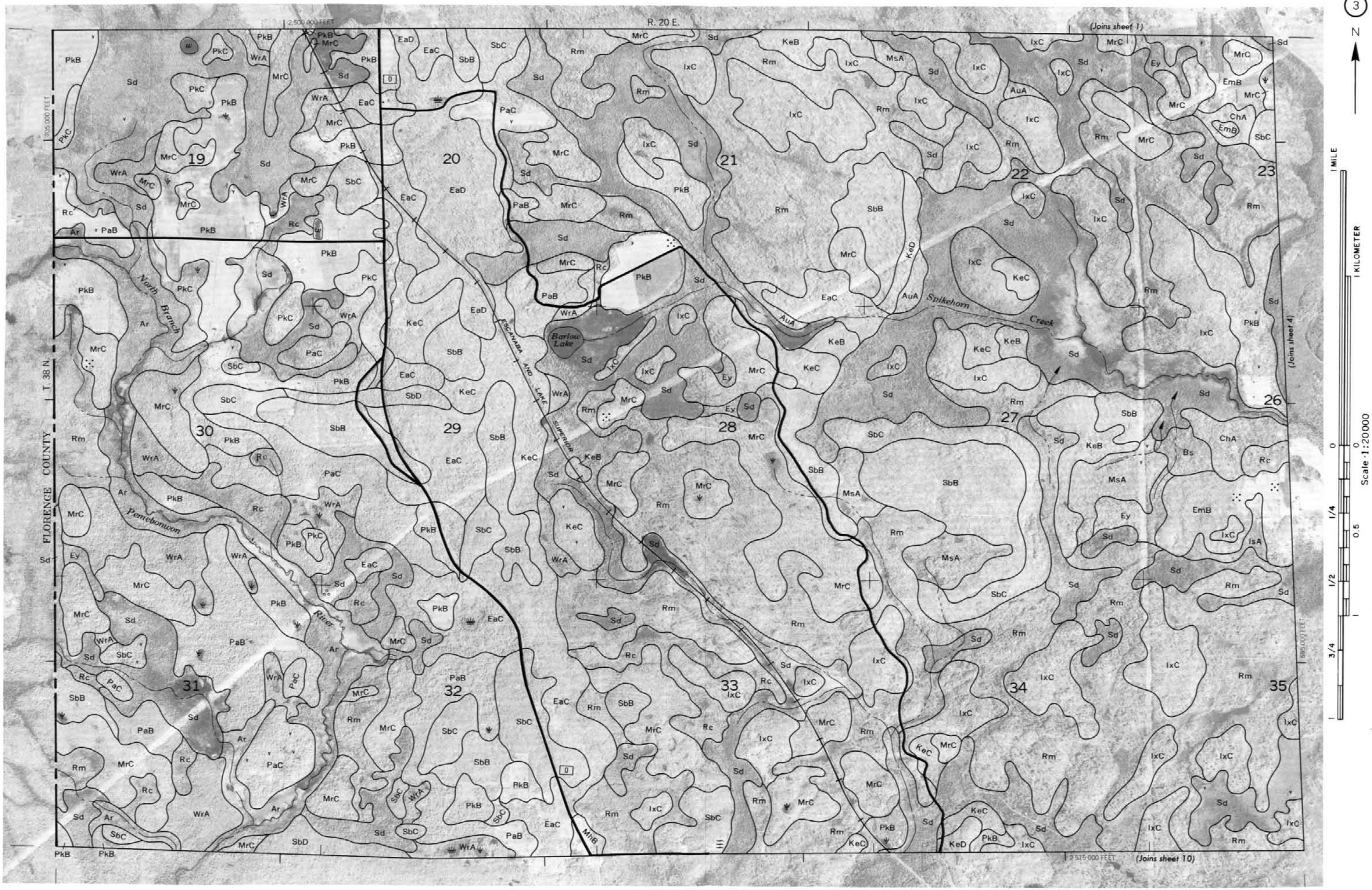
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 1



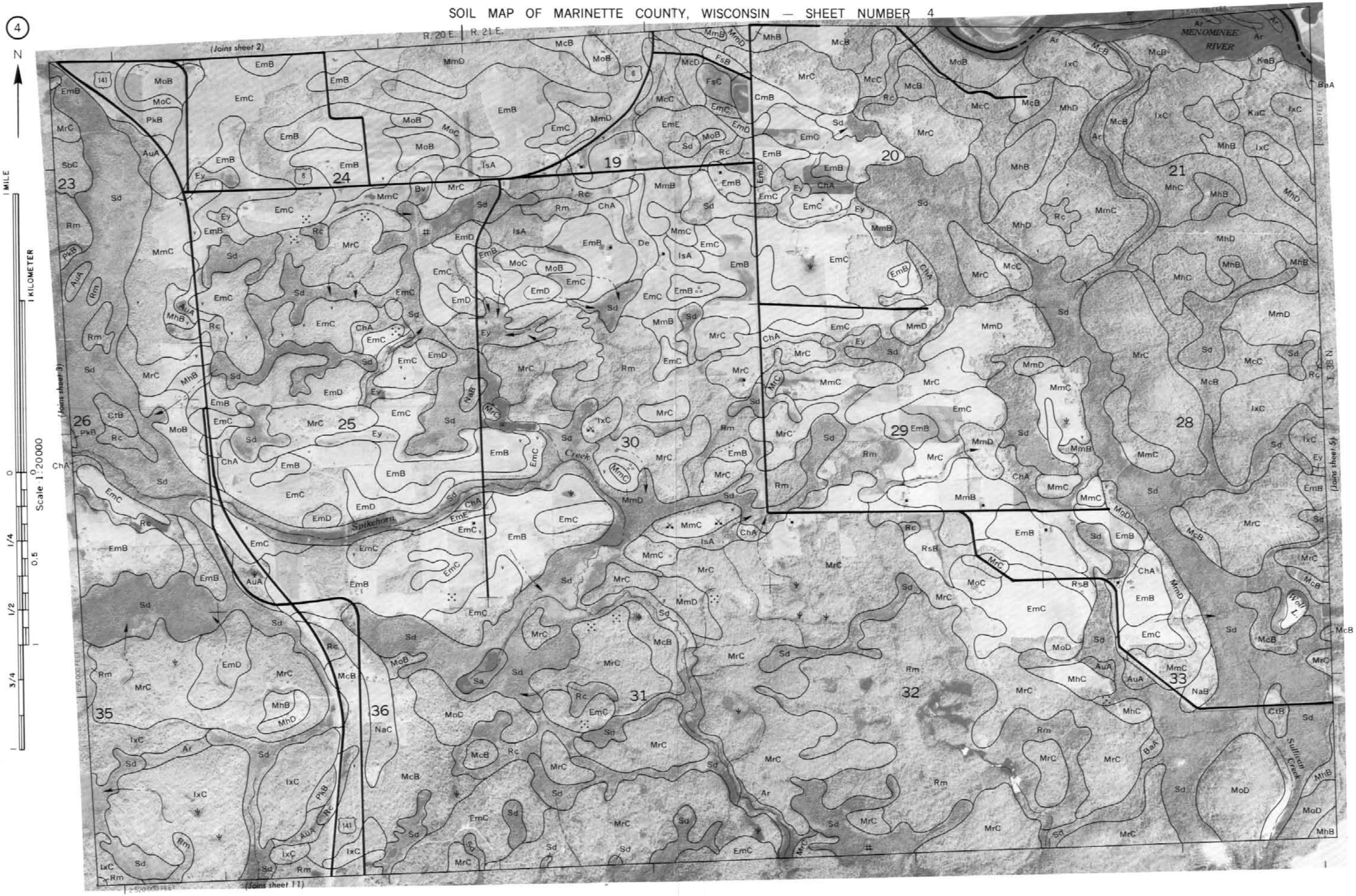
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 2



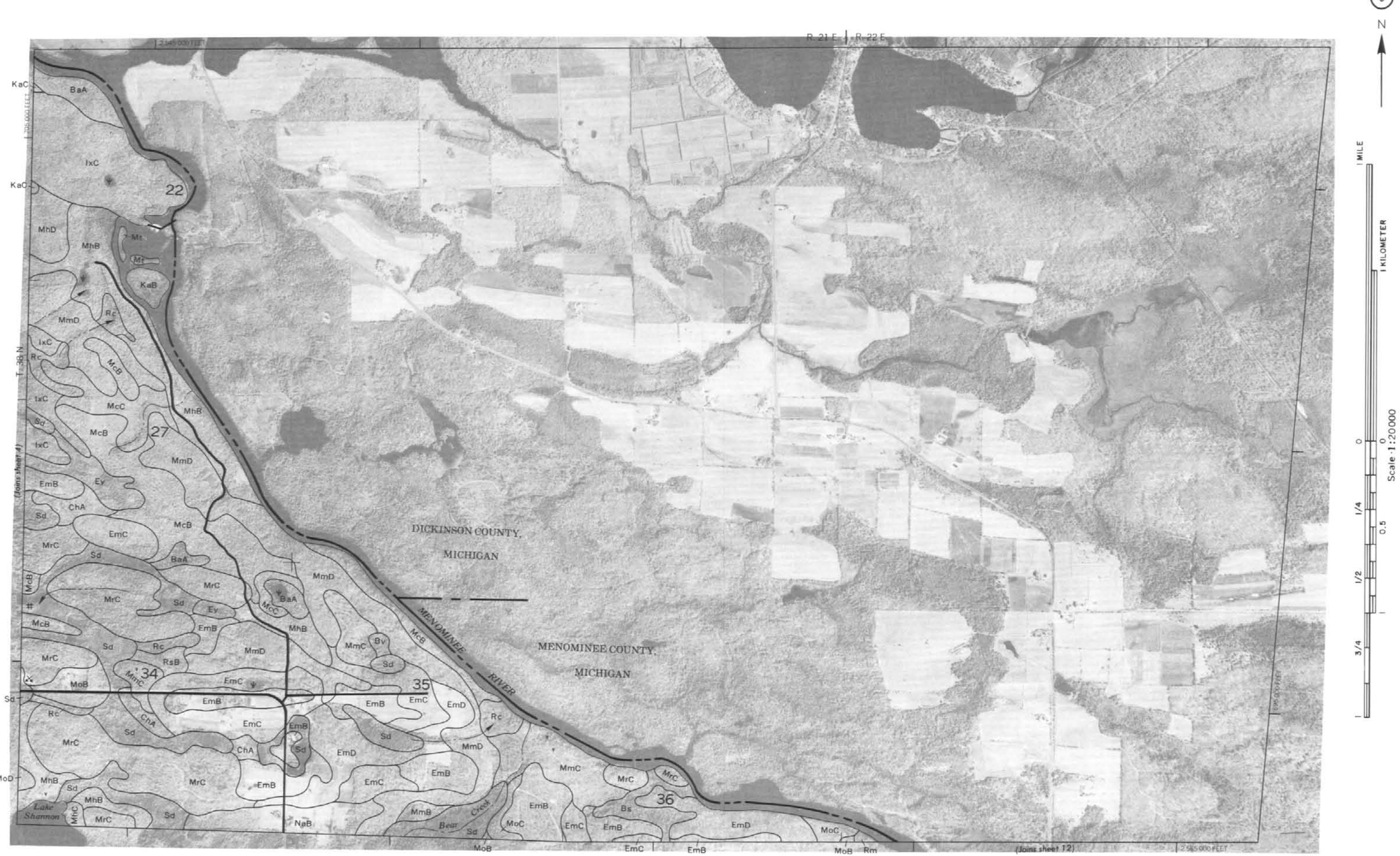
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 3

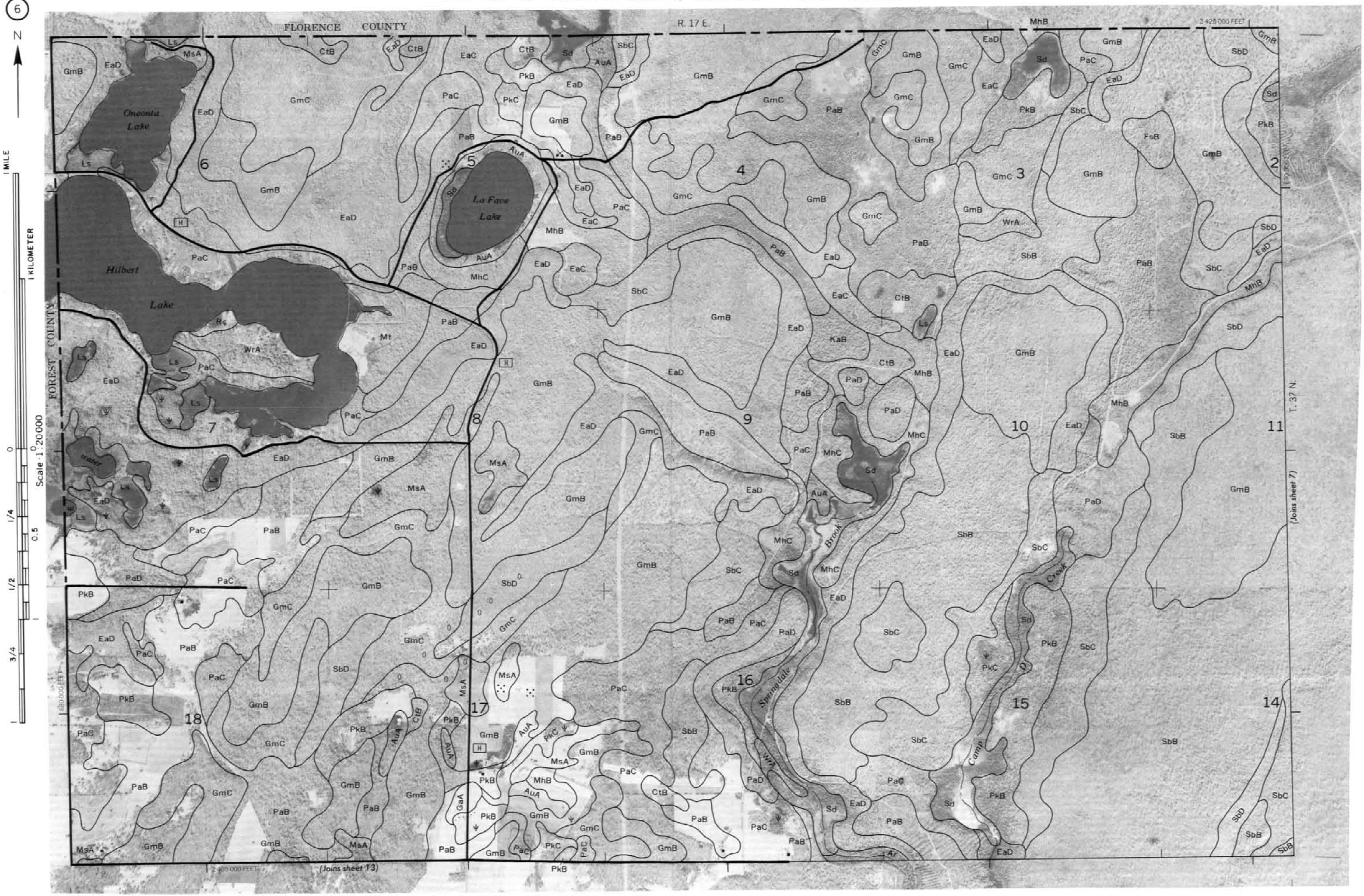


SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 4

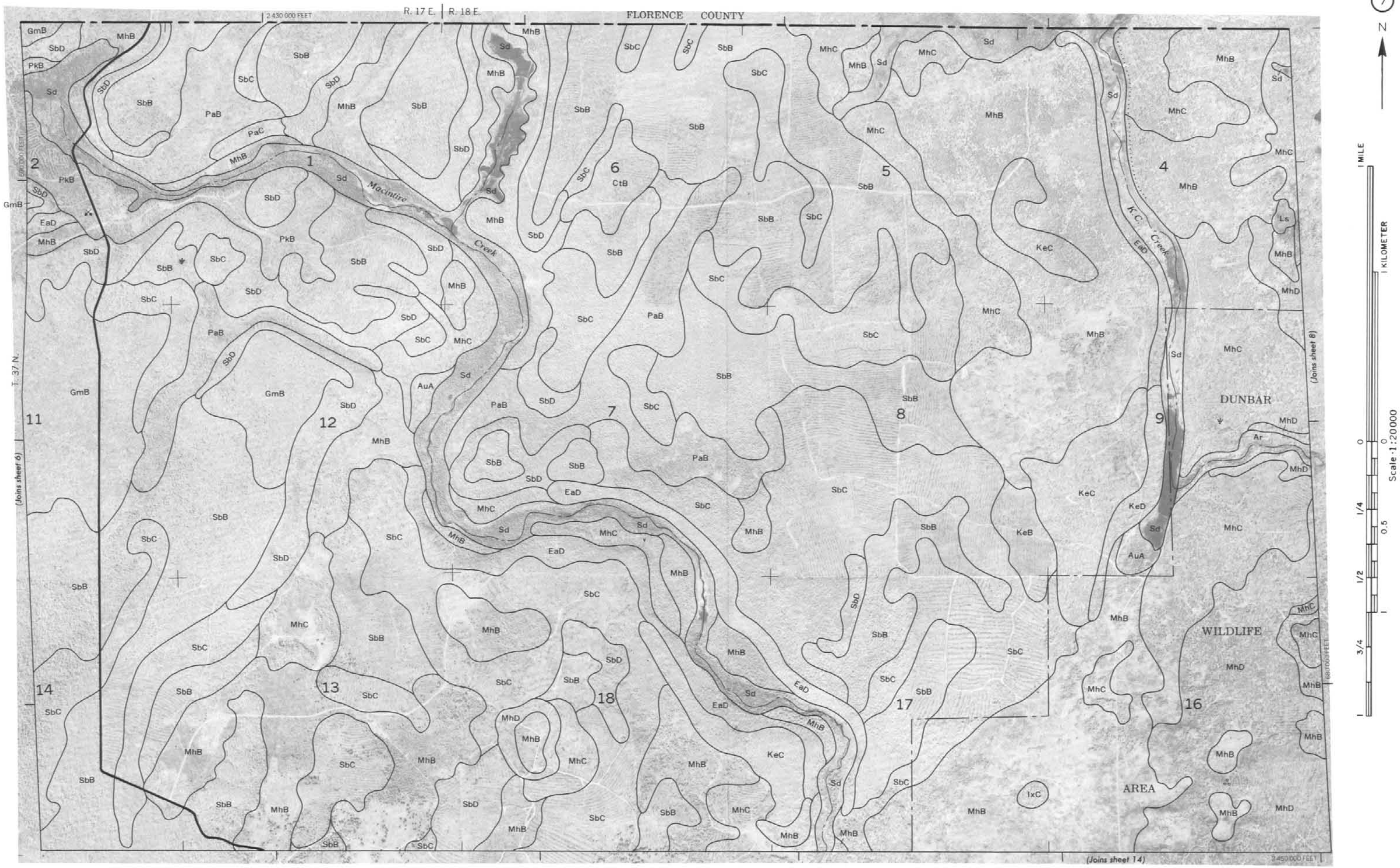


SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 5

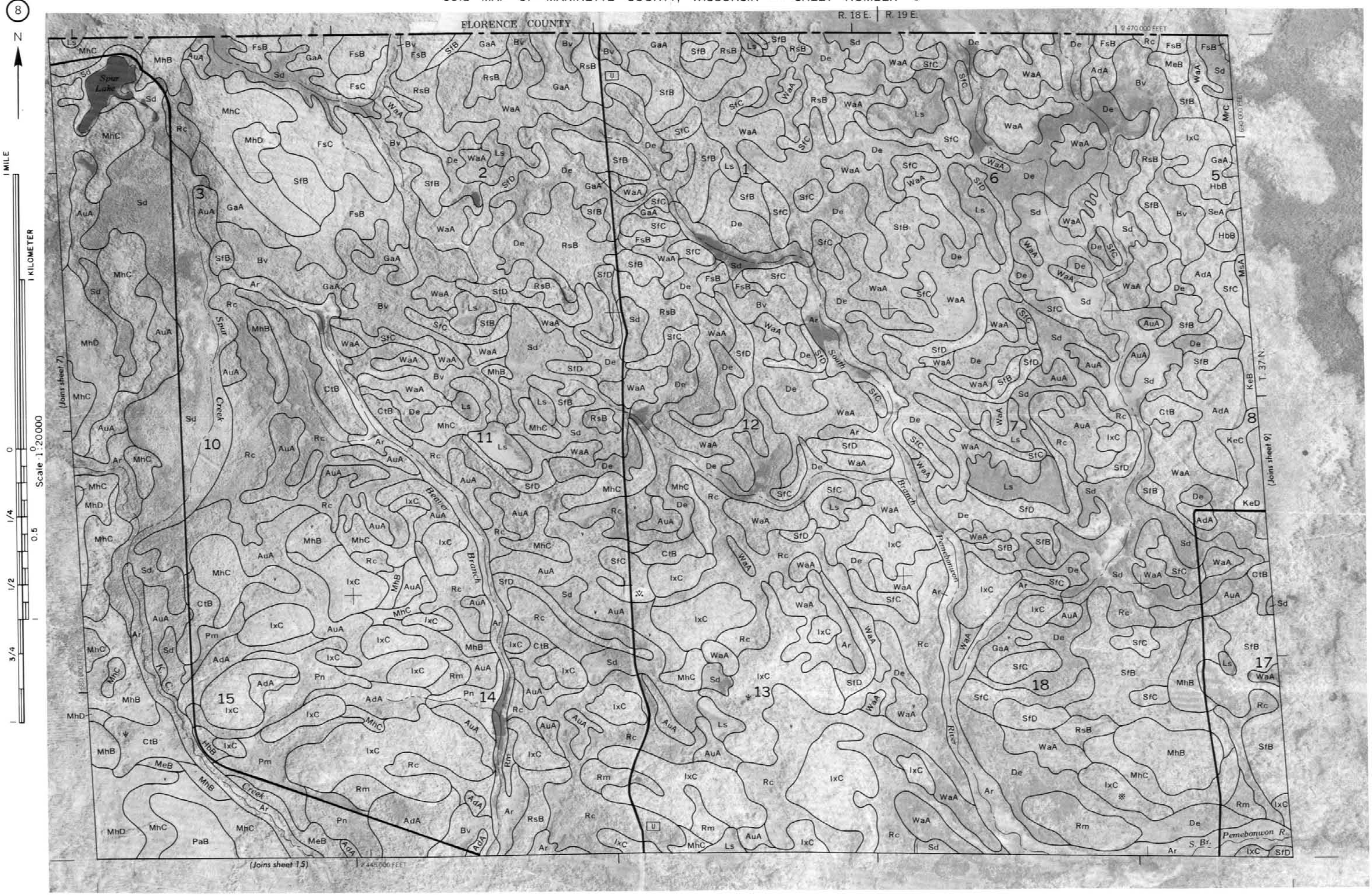


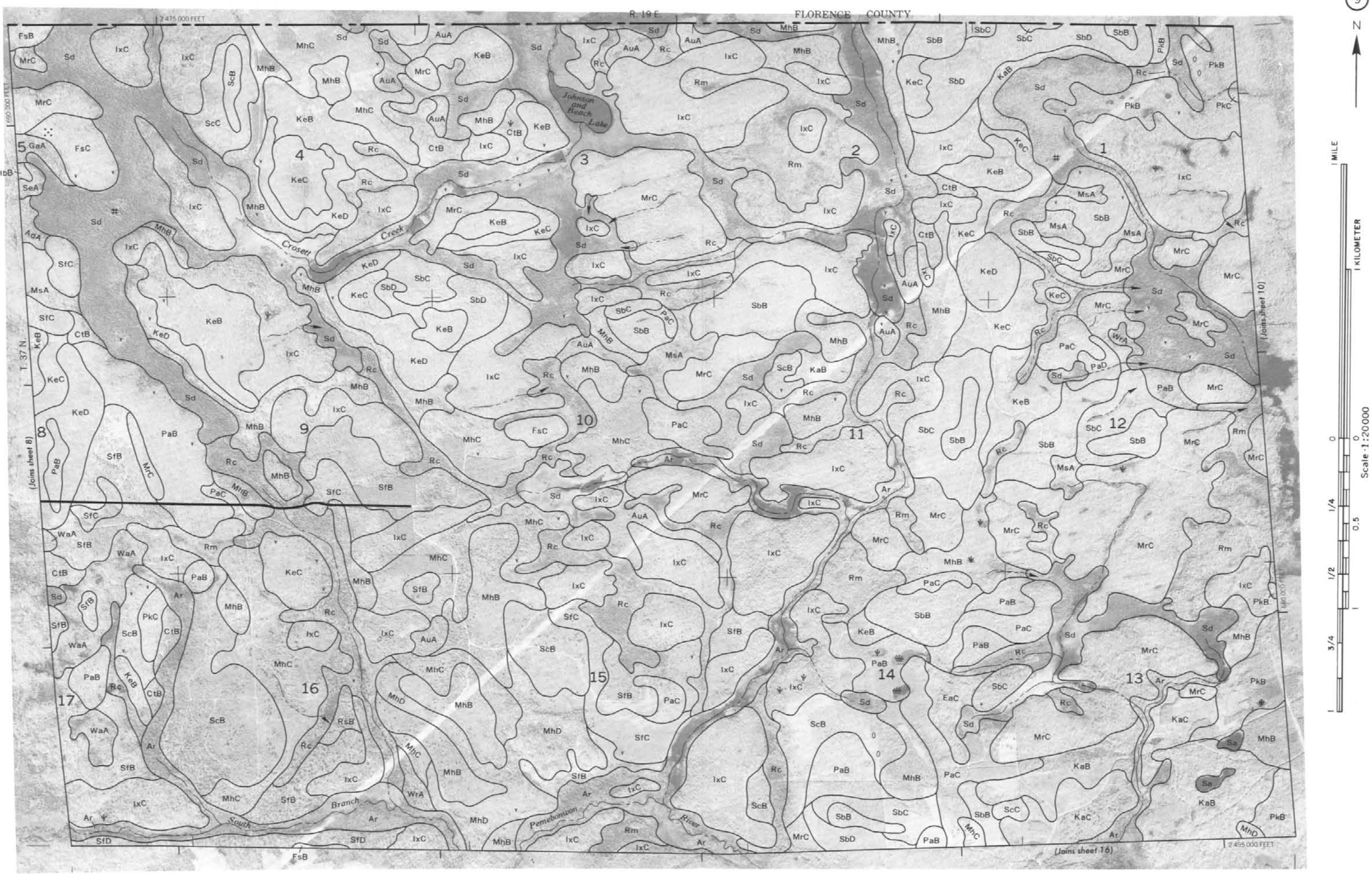

N
FLORENCE COUNTY
R. 17 E.
2 425 000 FEET
FOREST COUNTY
T. 37 N.
(Joins sheet 7)
(Joins sheet 13)
2 405 000 FEET
Scale 1:20000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Oneonta Lake
Hilbert Lake
La Fave Lake
water
Springdale
Brook
Camp
Creek
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18
GmB
GmC
EaD
EaC
PaB
PaC
PaD
PkB
PkC
SbB
SbC
SbD
MhB
MhC
MsA
CtB
AuA
Sd
Ls
WrA
FsB
KaB
GaA
Mt
Rc
Ar

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 7

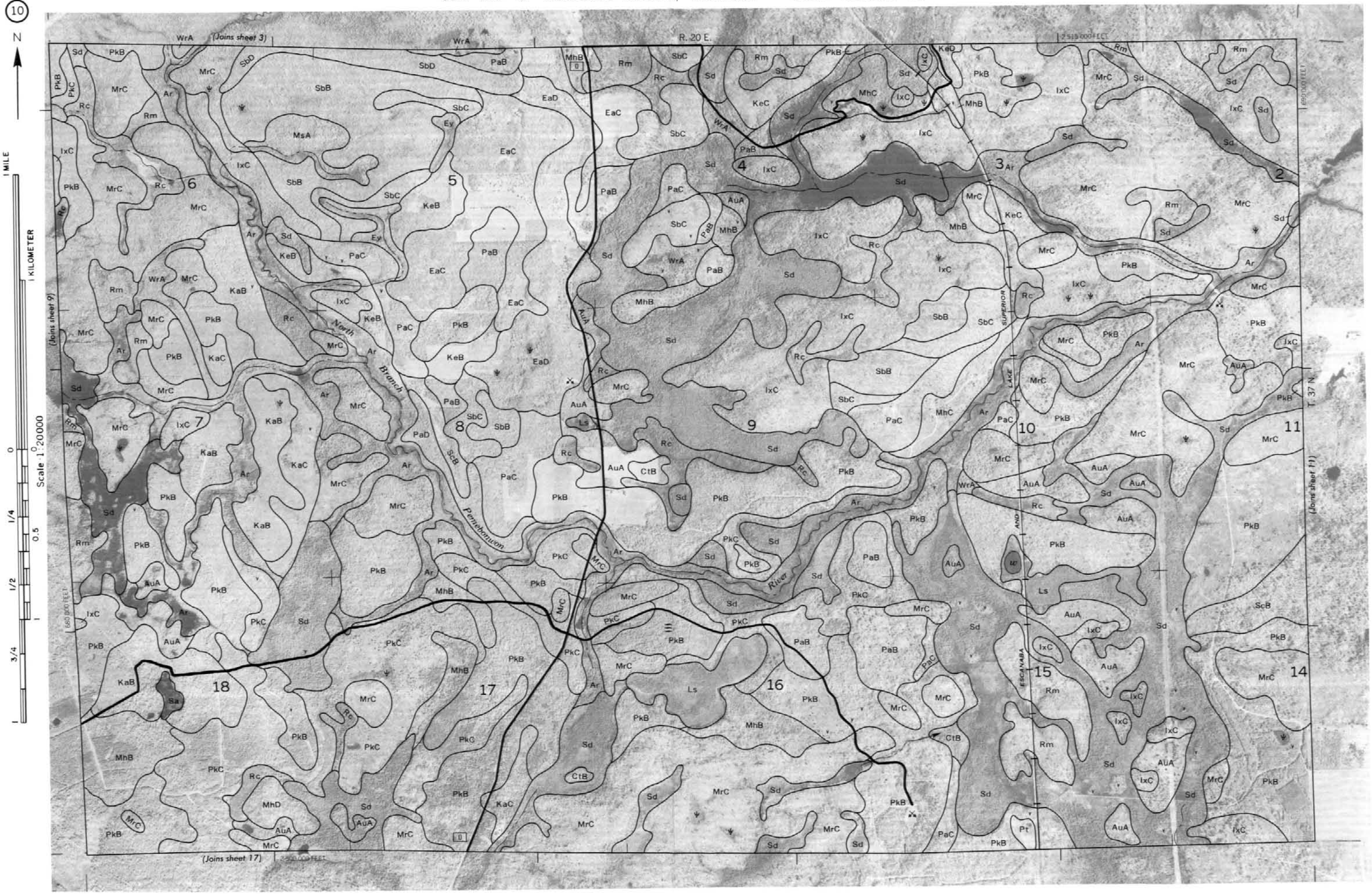


SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 8

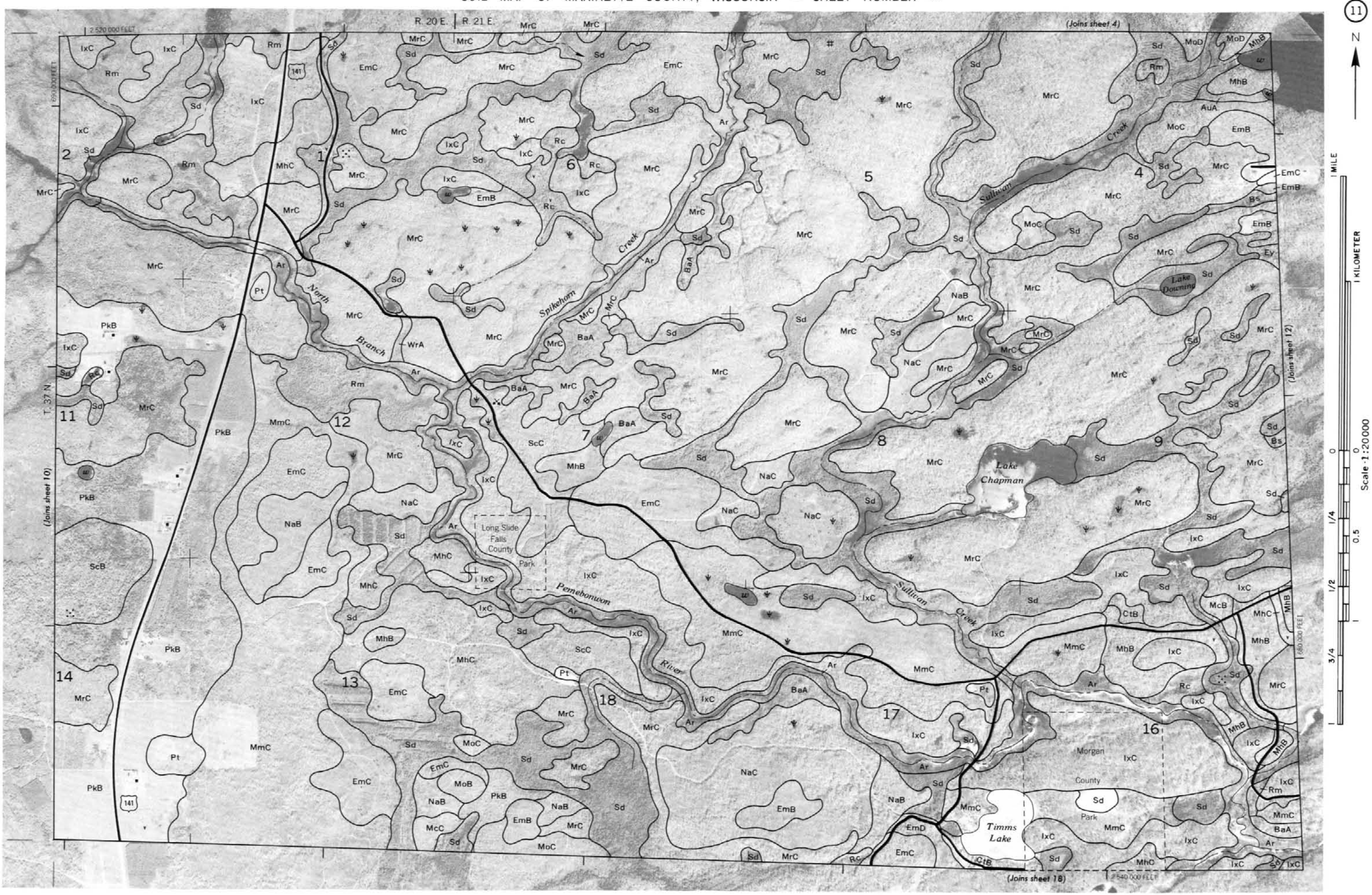



9
N
R. 19 E.
FLORENCE COUNTY
2 475 000 FEET
690 000 FEET
Johnson and Beach Lake
Crosett Creek
South Branch
Pemebonwon River
T. 37 N.
(Joins sheet 8)
(Joins sheet 10)
(Joins sheet 16)
2 495 000 FEET
680 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1

10

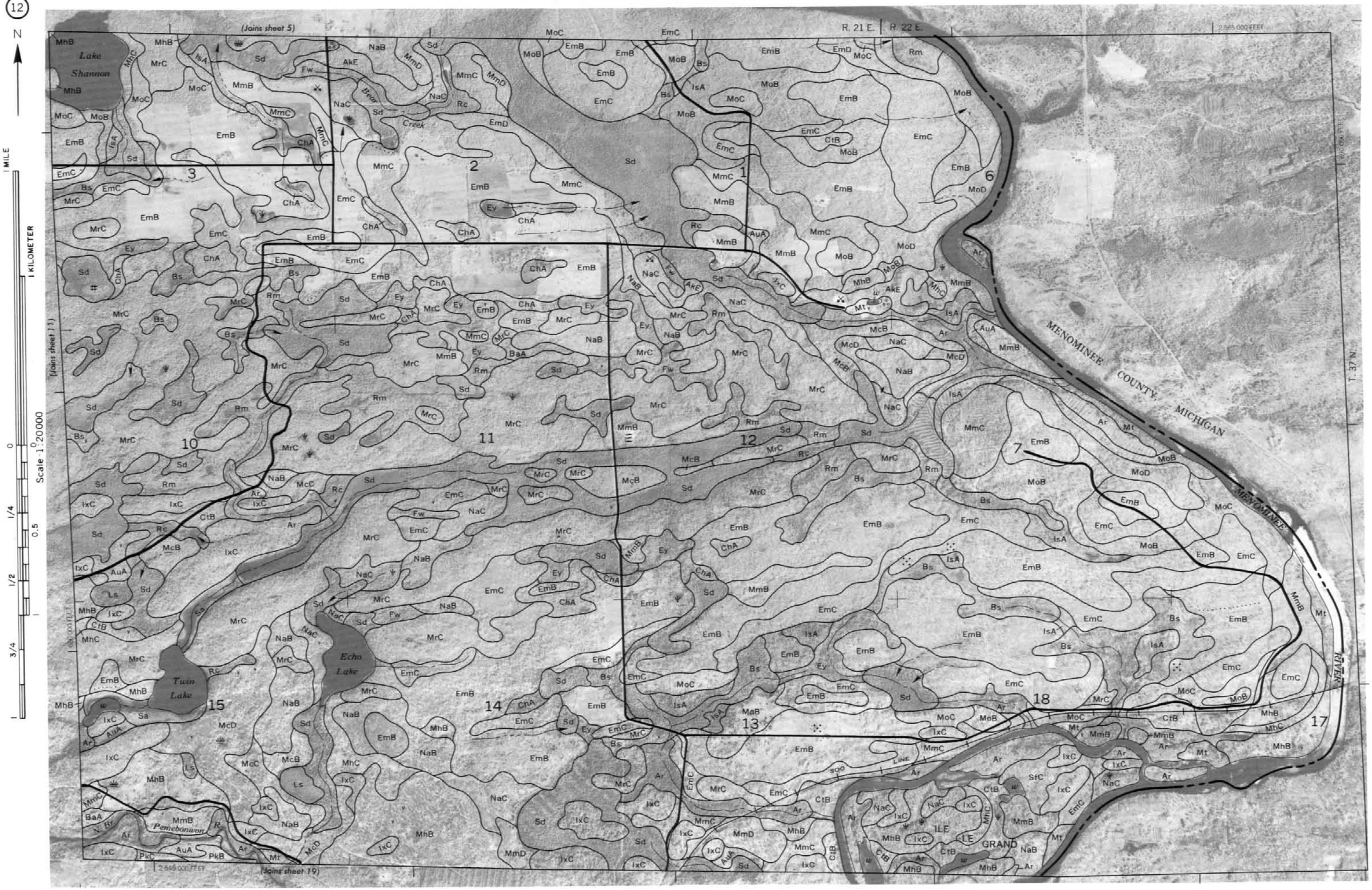


N
(Joins sheet 3)
R. 20 E.
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 17)
T. 37 N.
North Branch
Pemebonwon River
LAKE SUPERIOR AND ESCANABA
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1

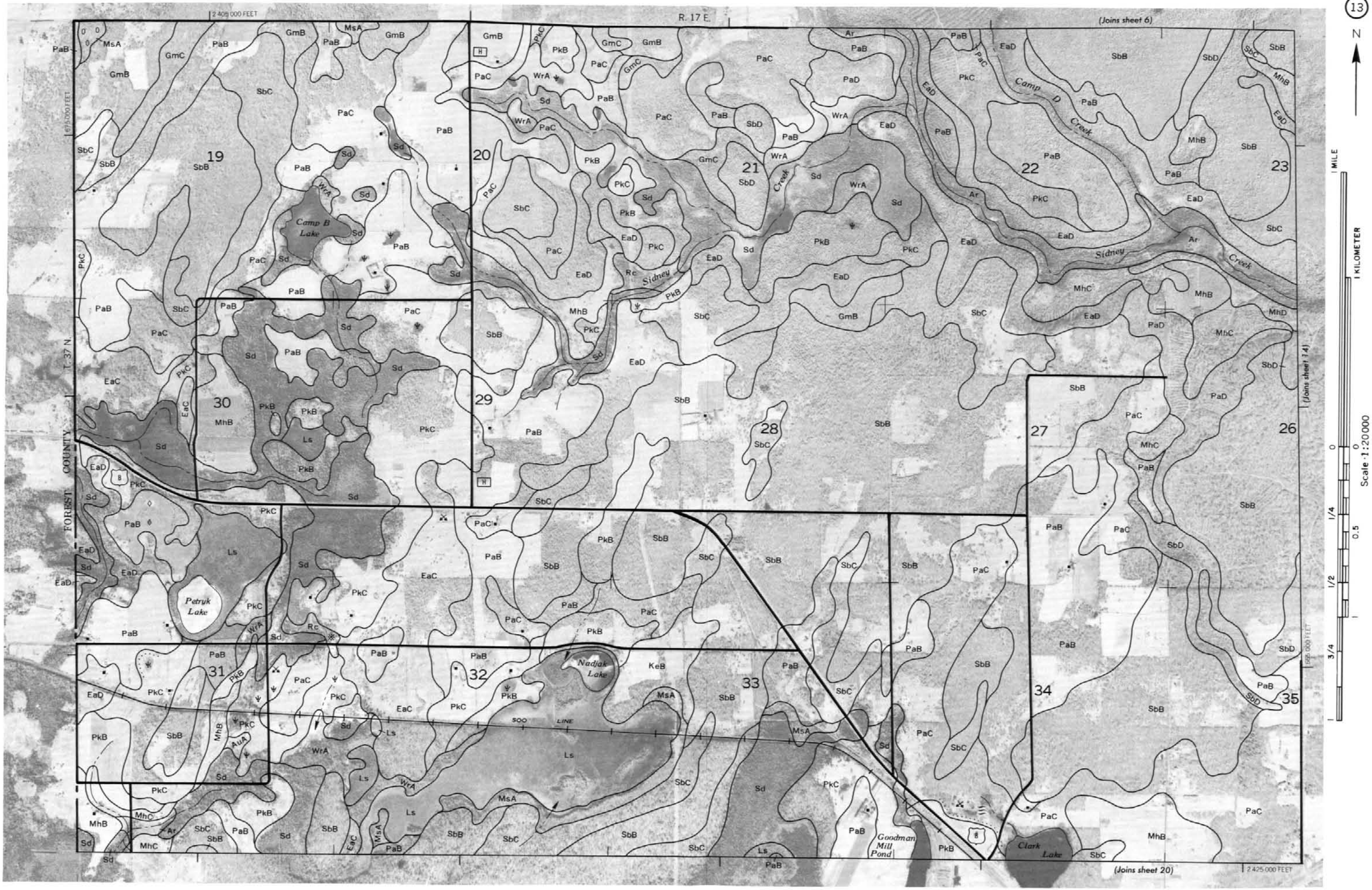


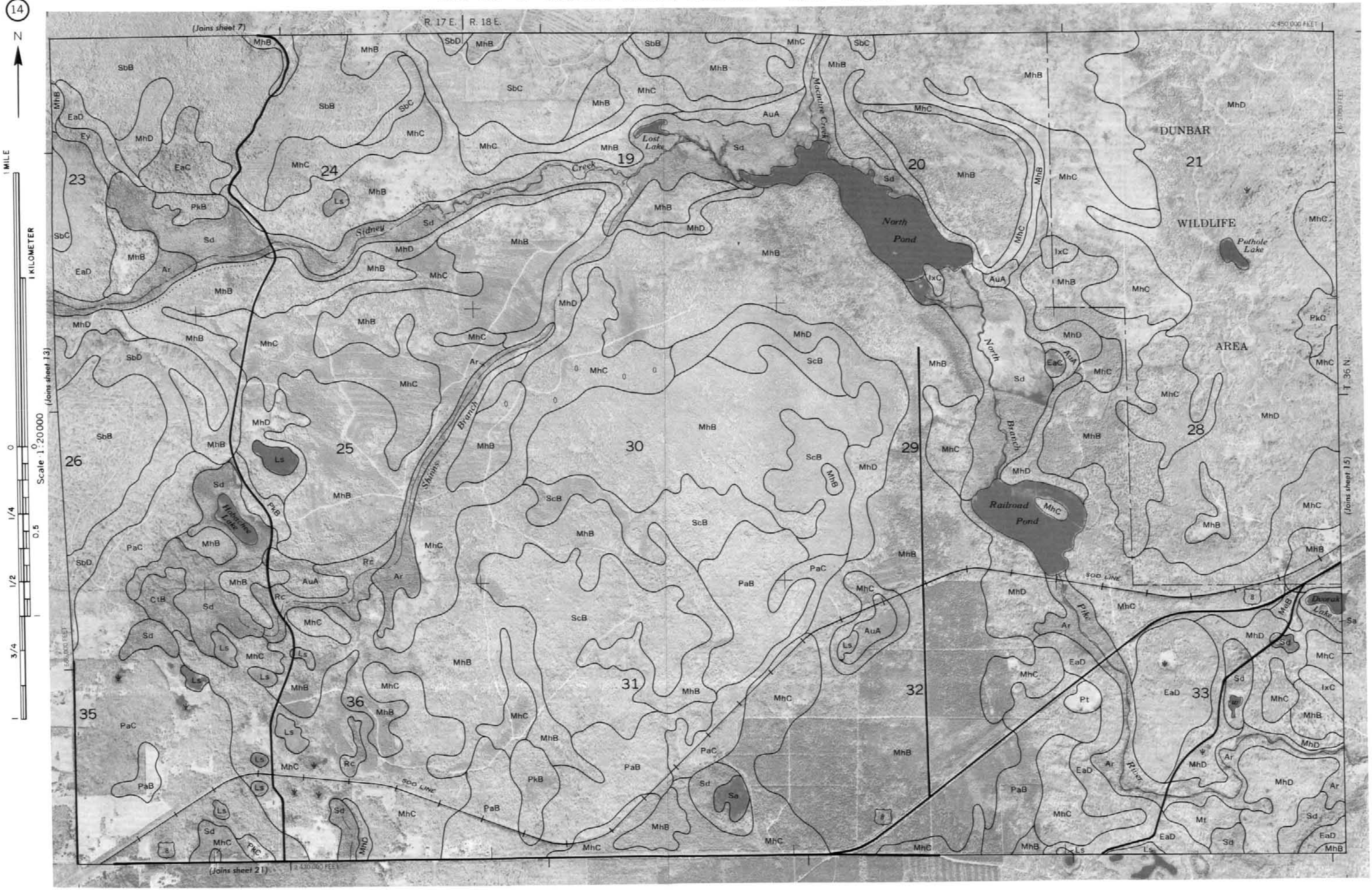
11
N
R. 20 E.
R. 21 E.
2 520 000 FEET
690 000 FEET
(Joins sheet 4)
(Joins sheet 10)
(Joins sheet 12)
(Joins sheet 18)
T. 37 N.
141
North Branch
Spikehorn Creek
Sullivan Creek
Lake Downing
Lake Chapman
Long Slide Falls County Park
Pemebonwon River
Timms Lake
Morgan County Park
680 000 FEET
2 540 000 FEET
1 MILE
1 KILOMETER
Scale 1:20 000

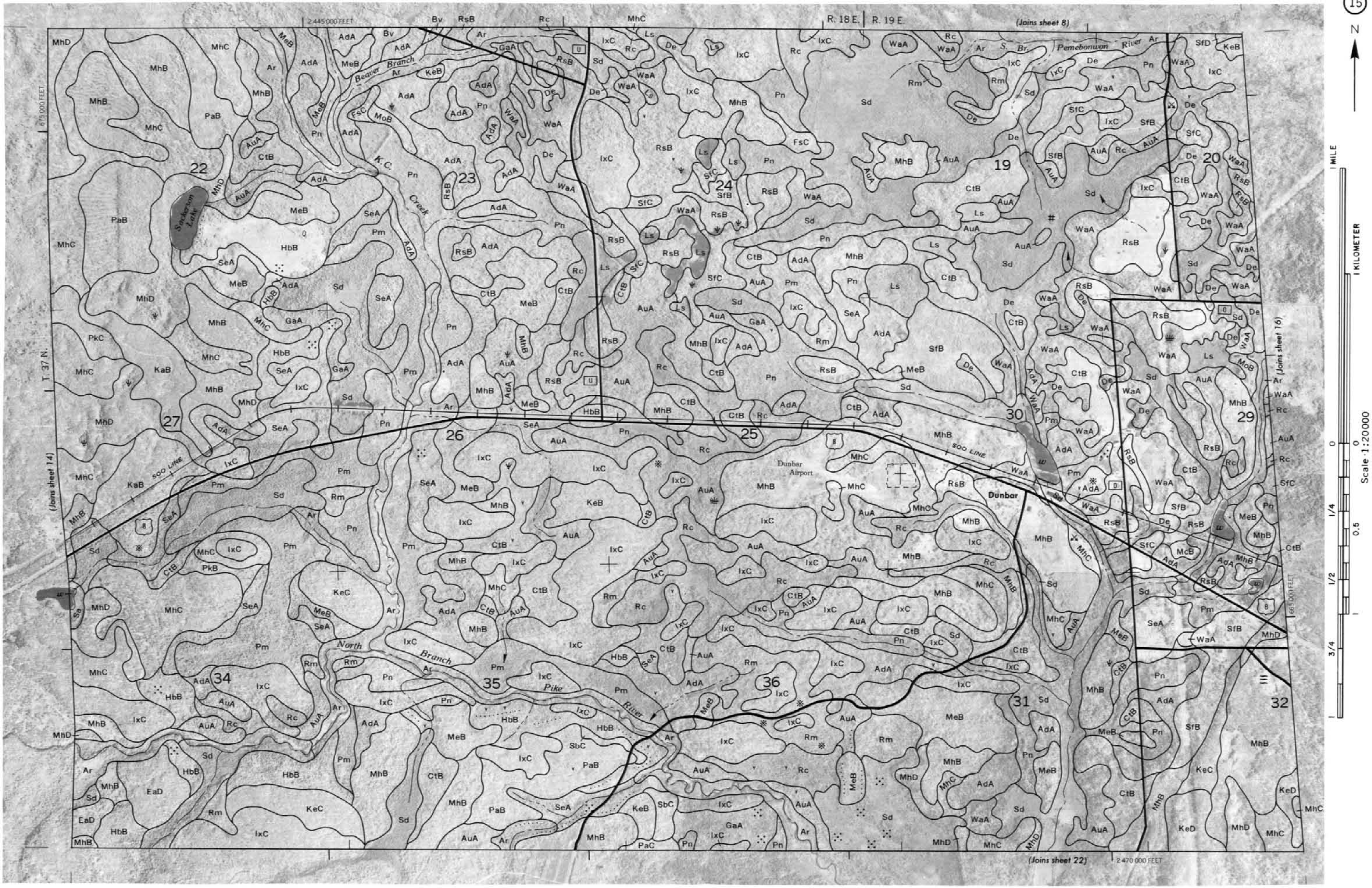
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 12

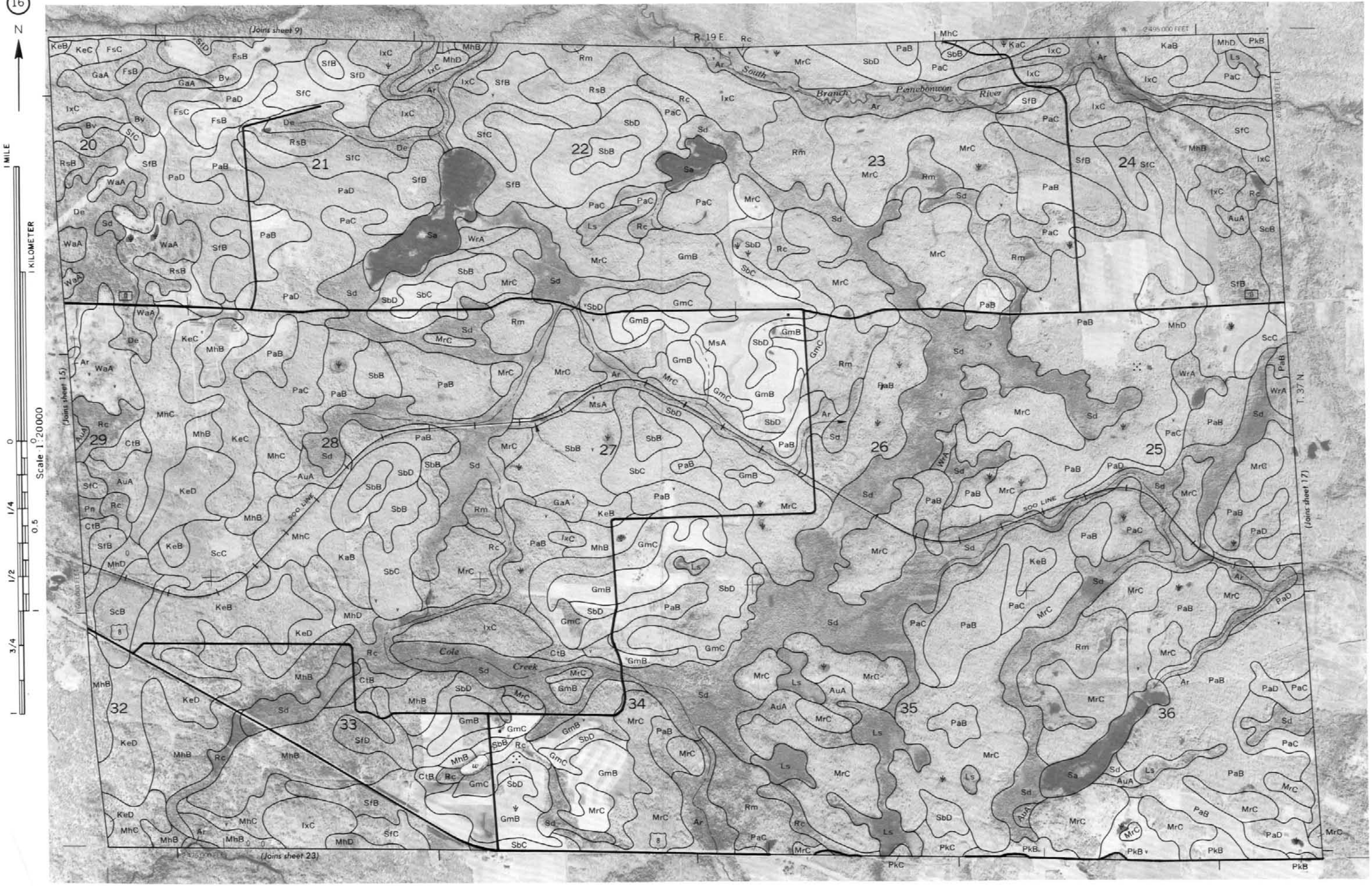


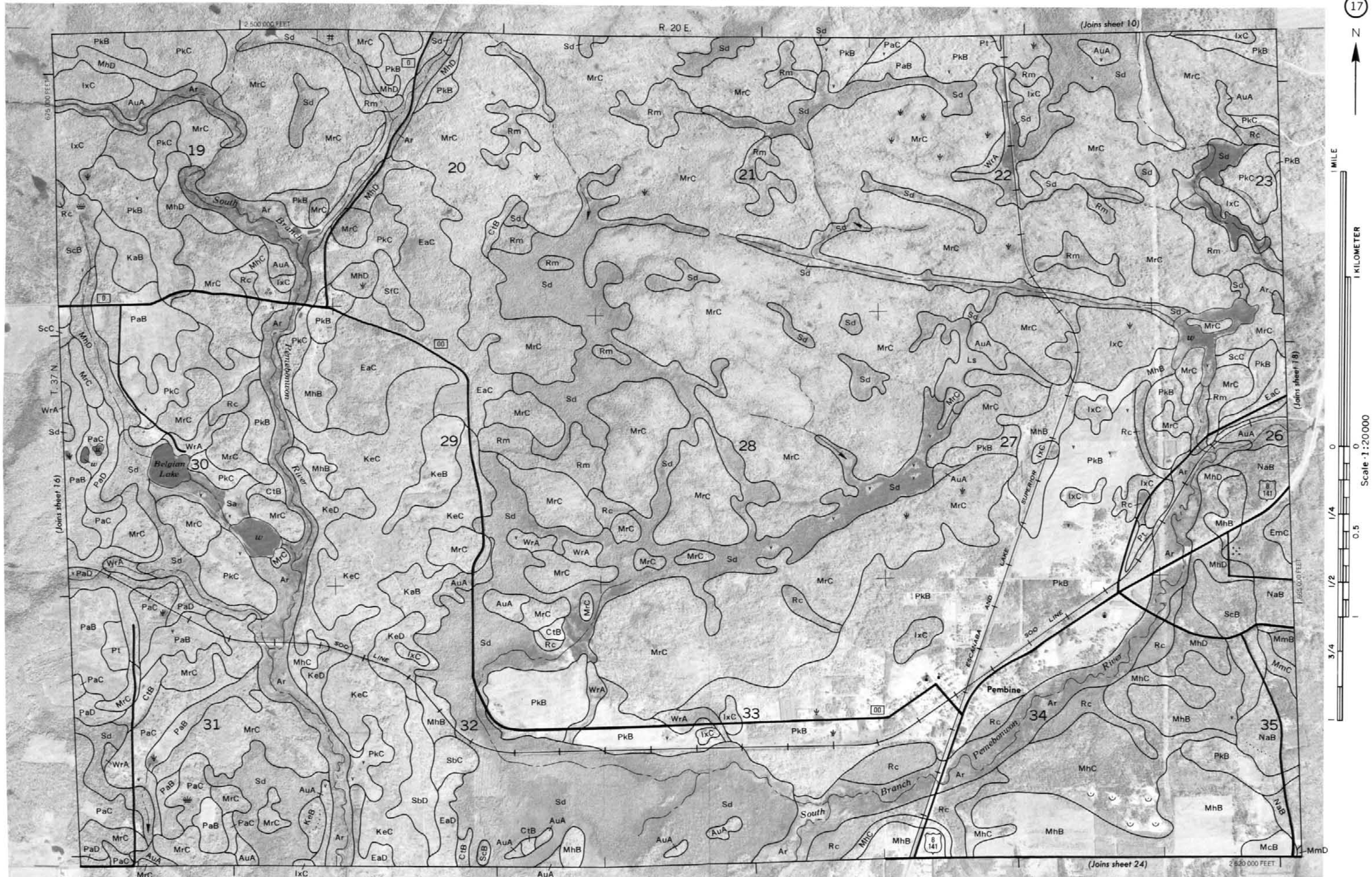
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 13

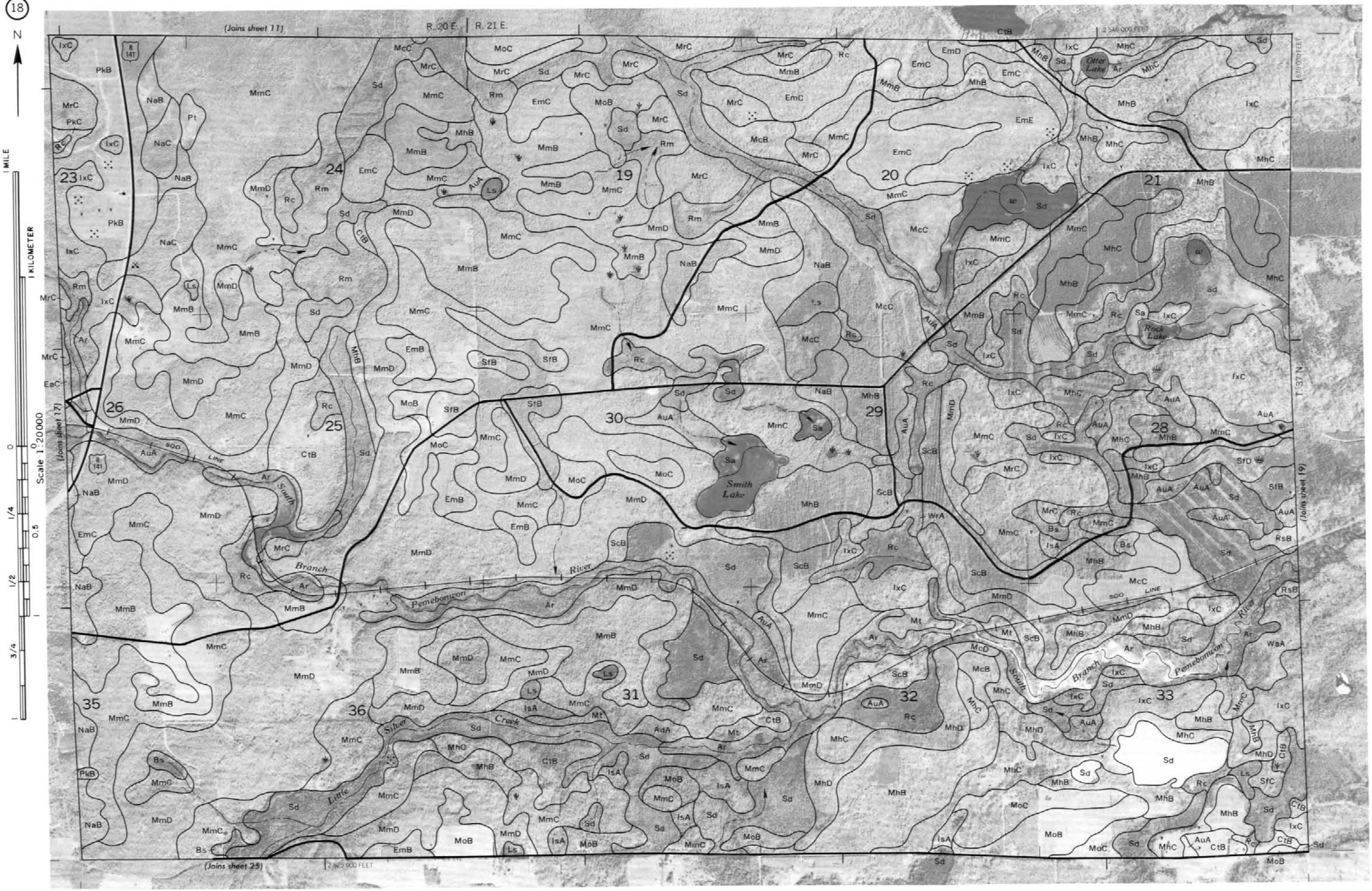


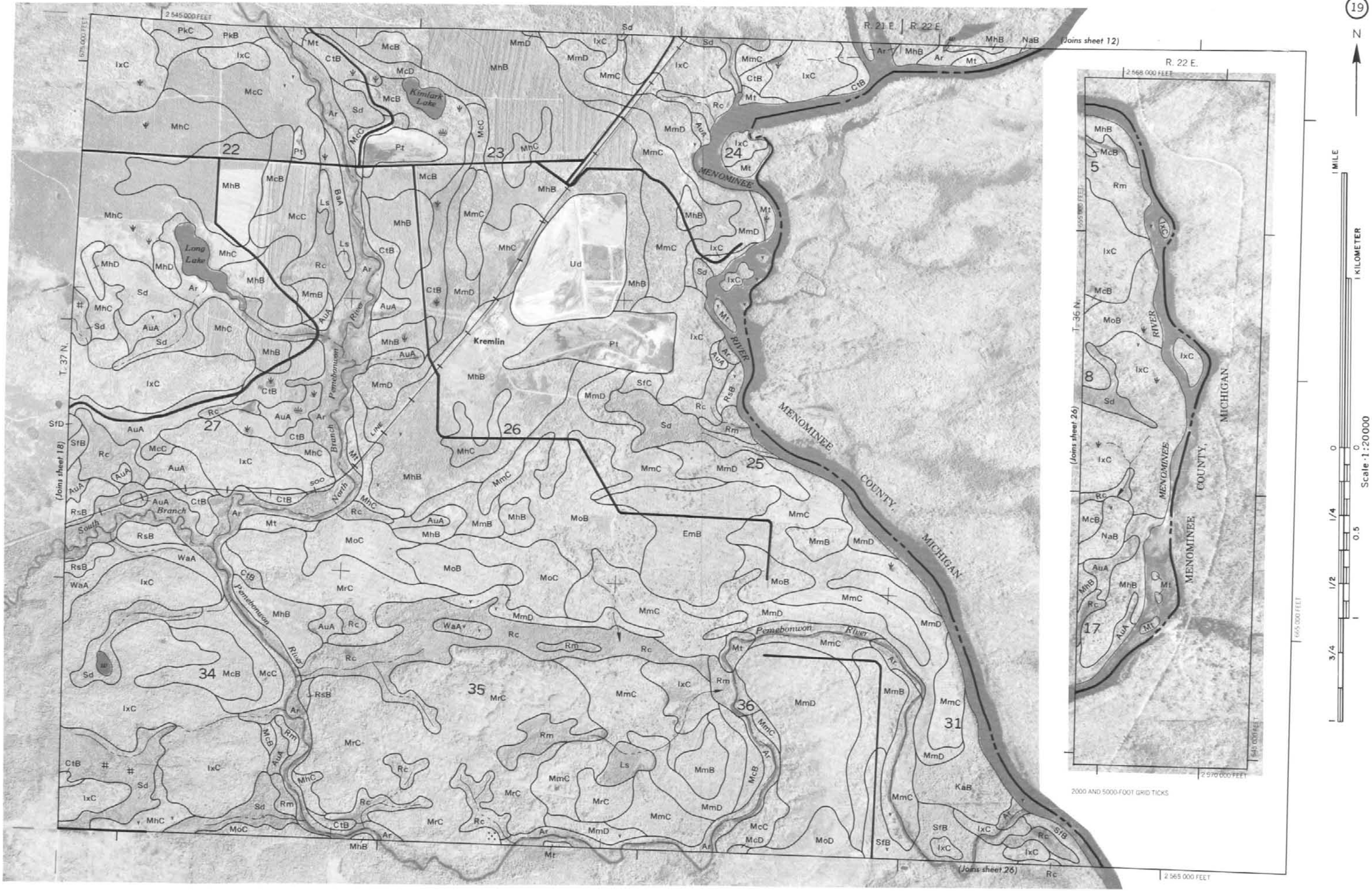

14
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 7)
R. 17 E. | R. 18 E.
2 450 000 FEET
(Joins sheet 13)
(Joins sheet 15)
(Joins sheet 21)
T. 36 N.
DUNBAR
WILDLIFE
AREA
Lost Lake
North Pond
Railroad Pond
Pothole Lake
Hobachee Lake
Dvorak Lake
Sidney Creek
Macintire Creek
North Branch
Shinns Branch
Pike River
SOO LINE
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36


15
N
(Joins sheet 8)
R. 18 E.
R. 19 E.
2 445 000 FEET
2 470 000 FEET
T. 37 N.
(Joins sheet 14)
(Joins sheet 16)
(Joins sheet 22)
Sackerson Lake
Beaver Branch
K.C. Creek
S. Br. Pemebonwon River
North Branch Pike River
SOO LINE
Dunbar
Dunbar Airport
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

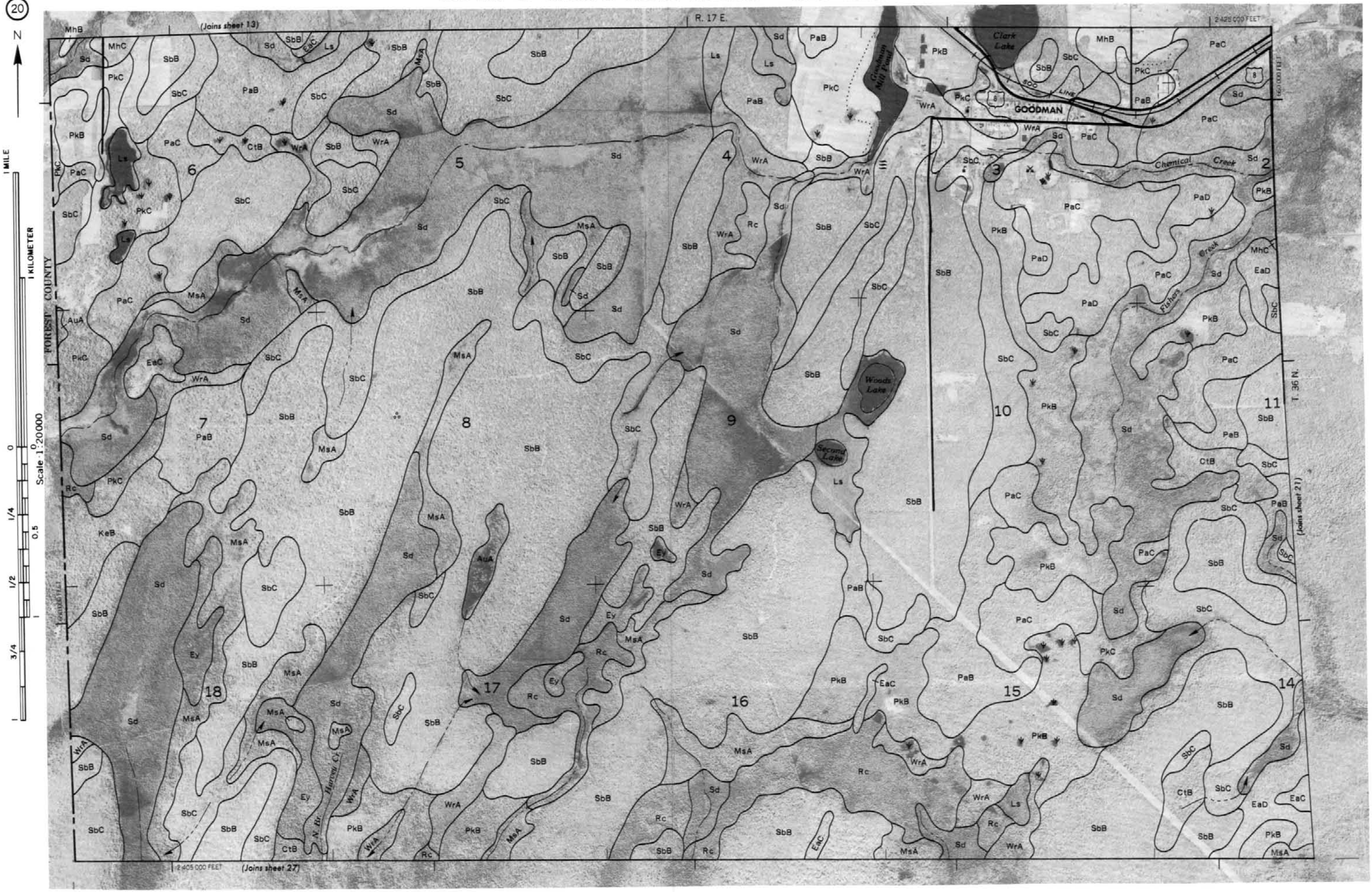

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
(Joins sheet 9)
R. 19 E.
South Branch Peshekee River
T. 37 N.
(Joins sheet 15)
(Joins sheet 17)
(Joins sheet 23)
SOO LINE
Cole Creek
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36


17
N
(Joins sheet 10)
(Joins sheet 16)
(Joins sheet 18)
(Joins sheet 24)
R. 20 E.
T. 37 N.
2 500 000 FEET
2 520 000 FEET
675 000 FEET
655 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
Belgian Lake
South Branch
Pemebonwon River
Pembine
SOO LINE
ESCANABA AND LAKE SUPERIOR
8
141
0
00
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35

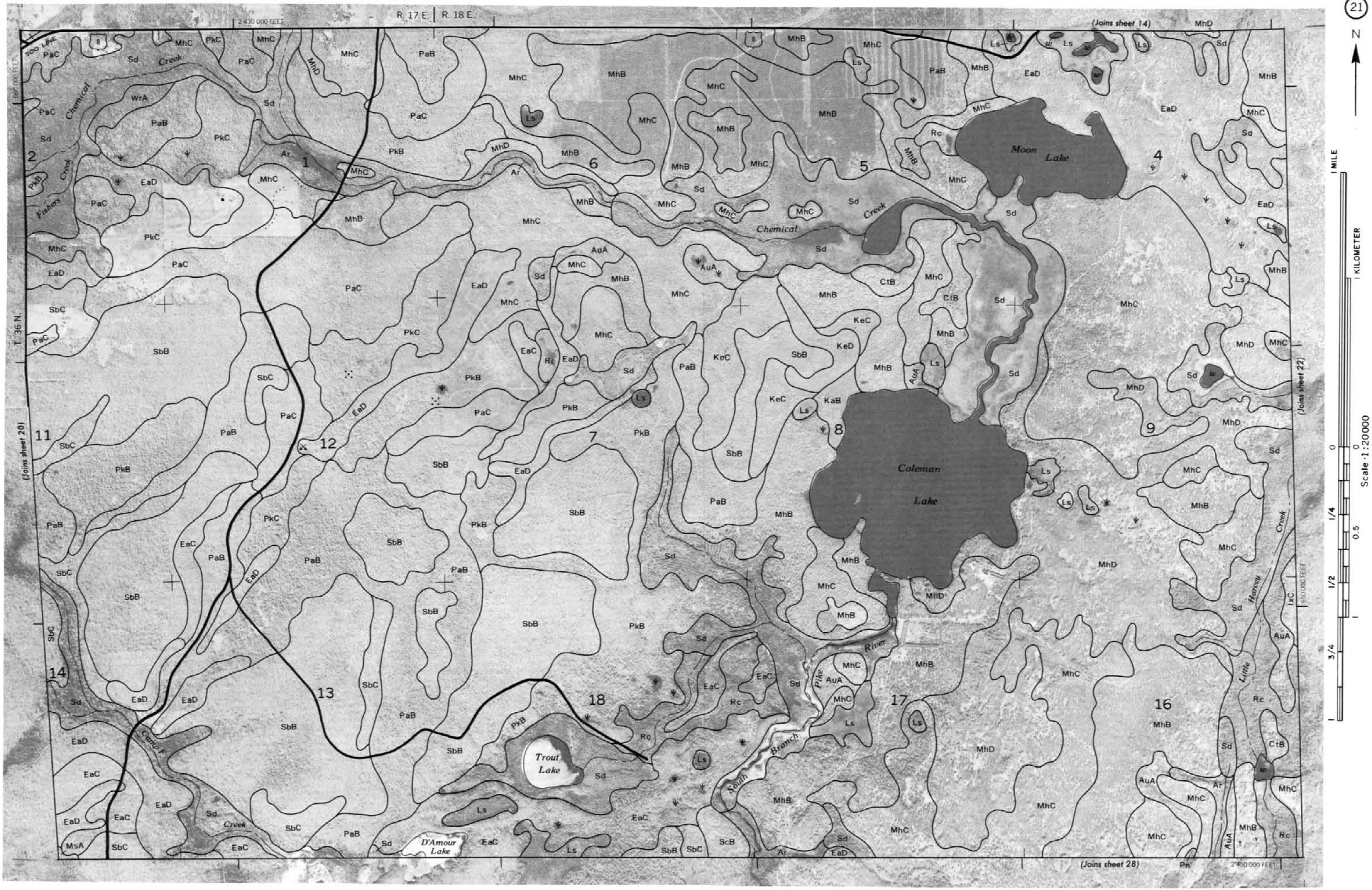

18
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 11)
R. 20 E.
R. 21 E.
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 25)
T. 37 N.
Otter Lake
Rock Lake
Smith Lake
South Branch
Pemebonwon River
Silver Creek
Little
SOO LINE


19
N
R. 21 E. | R. 22 E.
R. 22 E.
(Joins sheet 12)
(Joins sheet 18)
(Joins sheet 26)
(Joins sheet 26)
T. 37 N.
T. 36 N.
Kimlark Lake
Long Lake
Kremlin
SOO LINE
North Branch Pemebonwon River
South Branch
Pemebonwon River
MENOMINEE RIVER
MENOMINEE COUNTY, MICHIGAN
2 545 000 FEET
2 565 000 FEET
2 568 000 FEET
2 570 000 FEET
2000 AND 5000-FOOT GRID TICKS
1 MILE
1 KILOMETER
Scale 1:20000

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 20



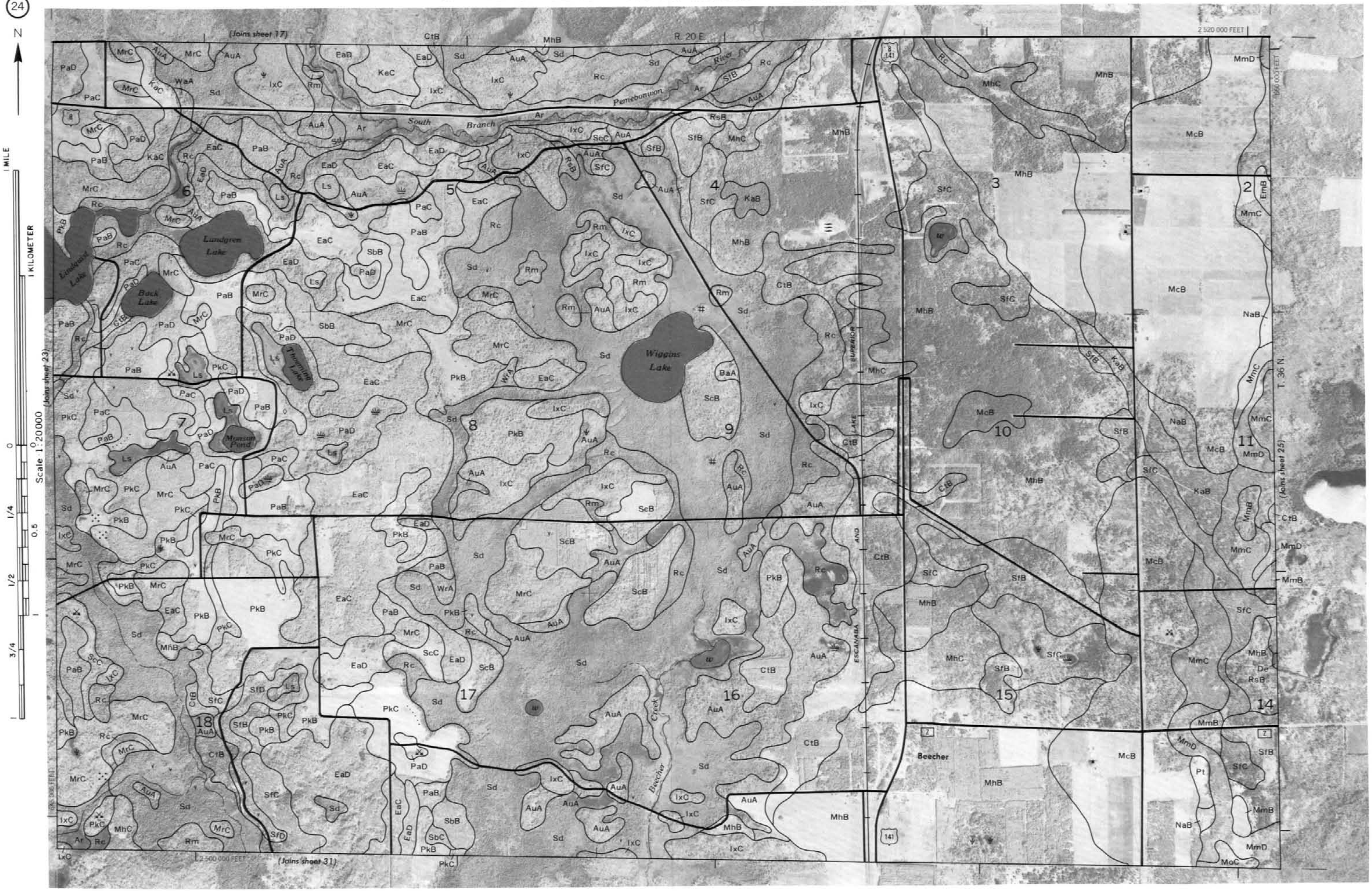
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 21

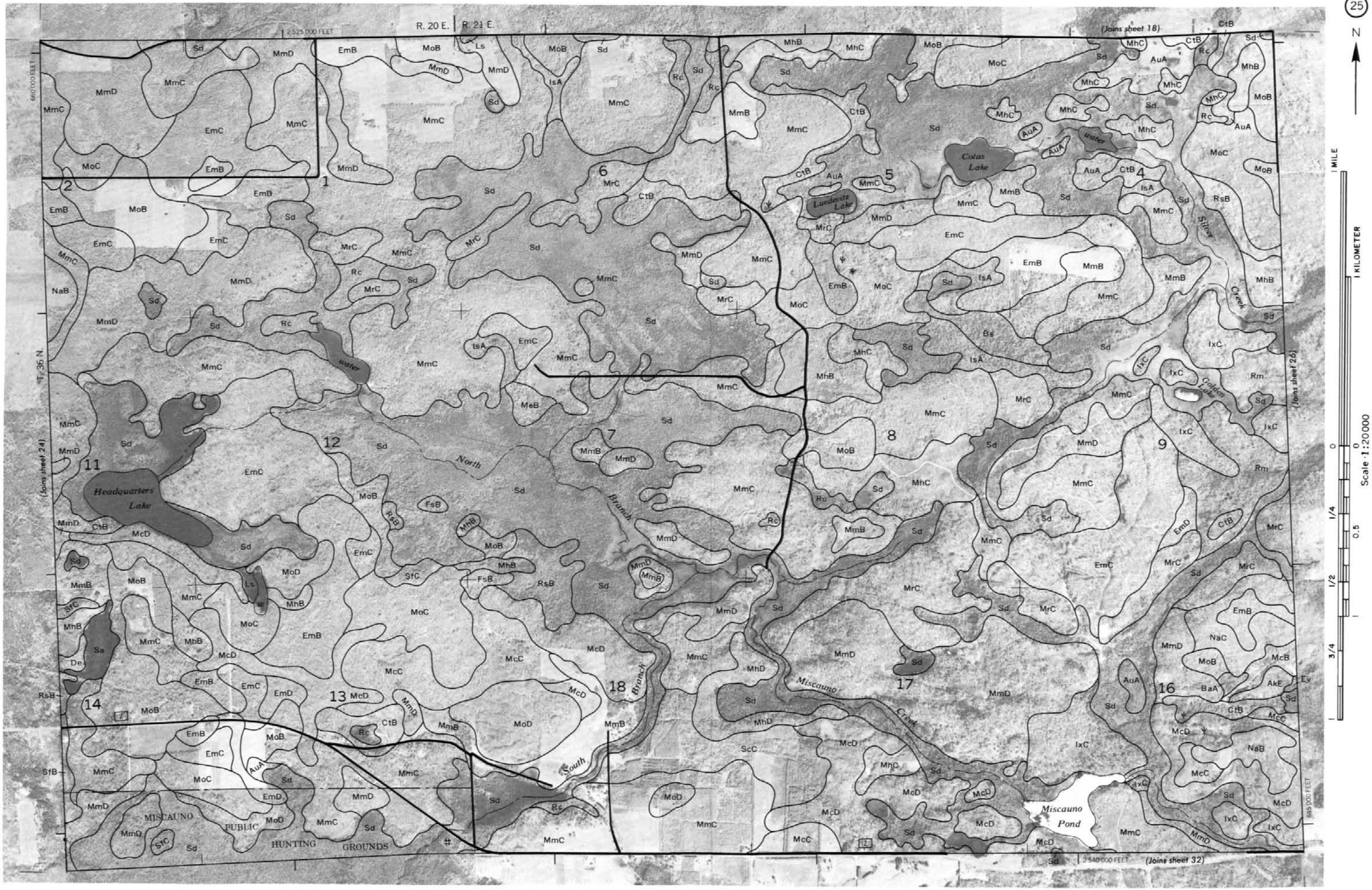



22
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
1
(Joins sheet 15)
(Joins sheet 21)
(Joins sheet 23)
(Joins sheet 29)
R. 18 E.
R. 19 E.
T. 36 N.
2 470 000 FEET
2 465 000 FEET
Kidd Lake
North Branch Pike River
Little Harvey Creek
water


23
N
R 19 E
T. 36 N.
(Joins sheet 16)
(Joins sheet 22)
(Joins sheet 24)
(Joins sheet 30)
2 475 000 FEET
2 495 000 FEET
North Branch Pike River
Cole Creek
Lily Lake
Minnie Lake
Young Lake
Lindquist Lake
Woemper Lake
West Pickerel Pond
East Pickerel Pond
Barnes Lake
Mud Lake
West Twin Lake
East Twin Lake
water
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

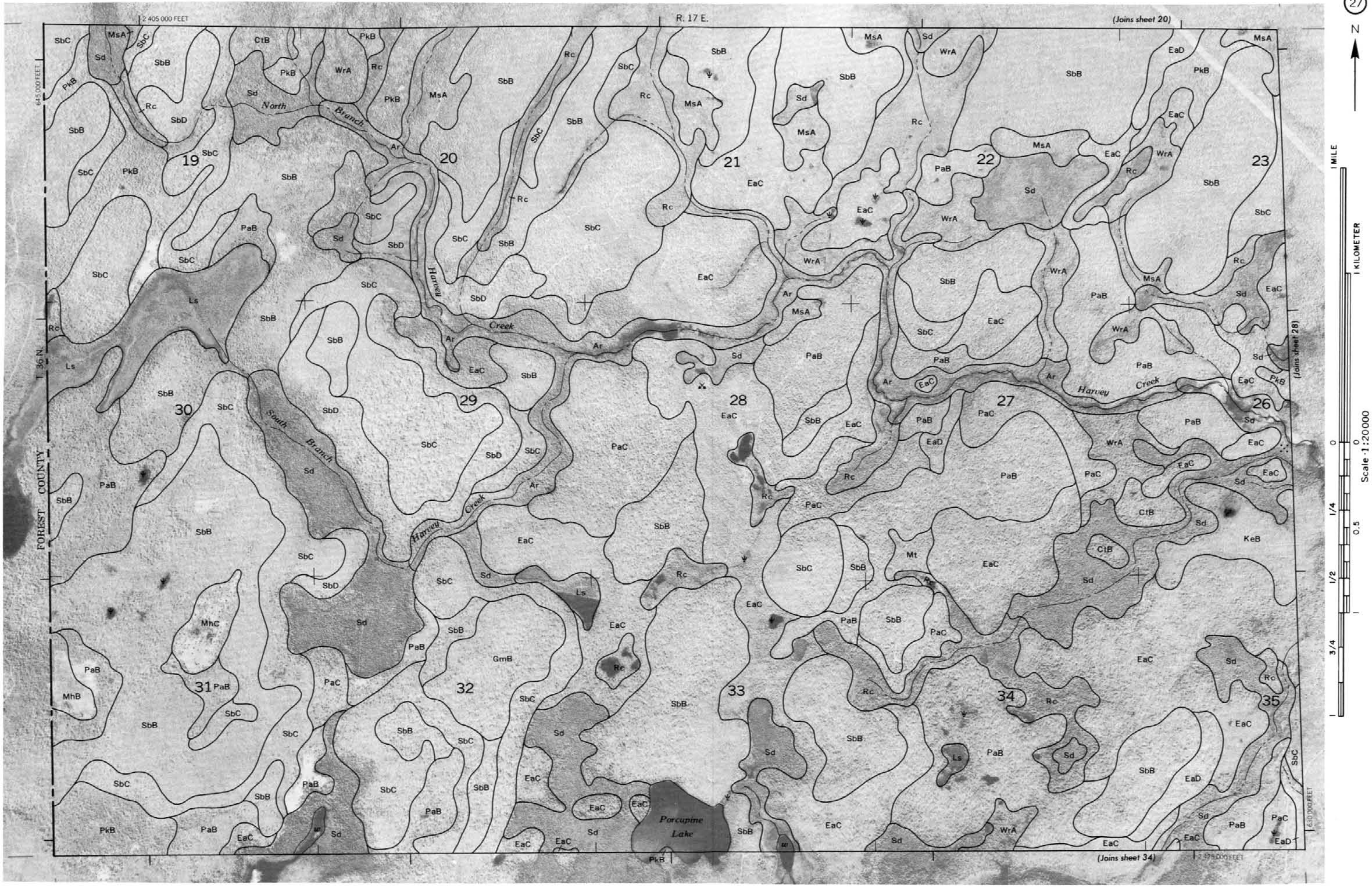
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 24




25
N
R. 20 E.
R. 21 E.
2 525 000 FEET
660 000 FEET
T. 36 N.
(Joins sheet 18)
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 32)
2 540 000 FEET
Headquarters Lake
Cotas Lake
Luedeeitz Lake
Golden Lake
Silver Lake Creek
Miscauno Pond
Miscauno Creek
North Branch
South Branch
MISCAUNO PUBLIC HUNTING GROUNDS
water
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

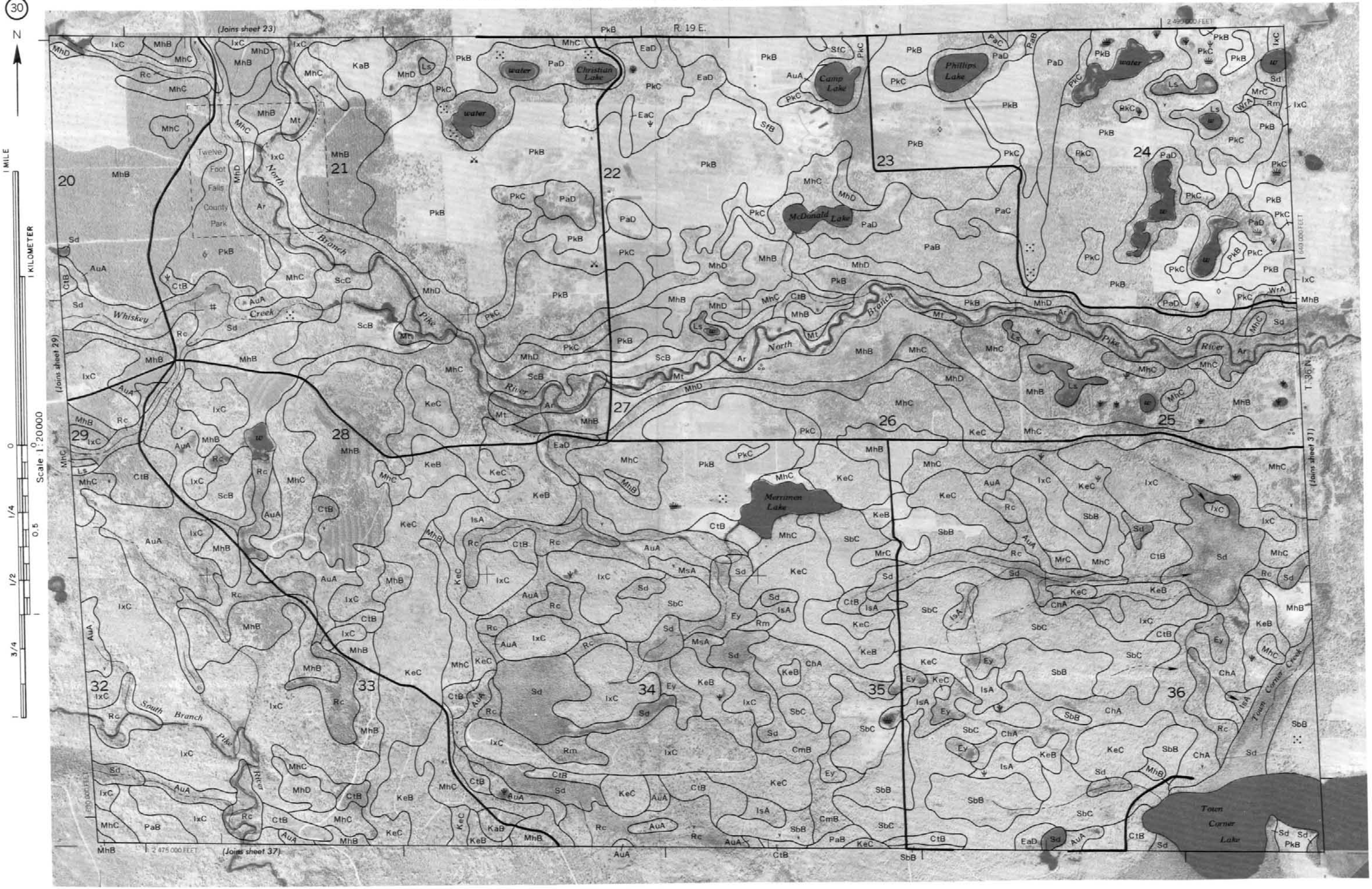
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 26

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 27

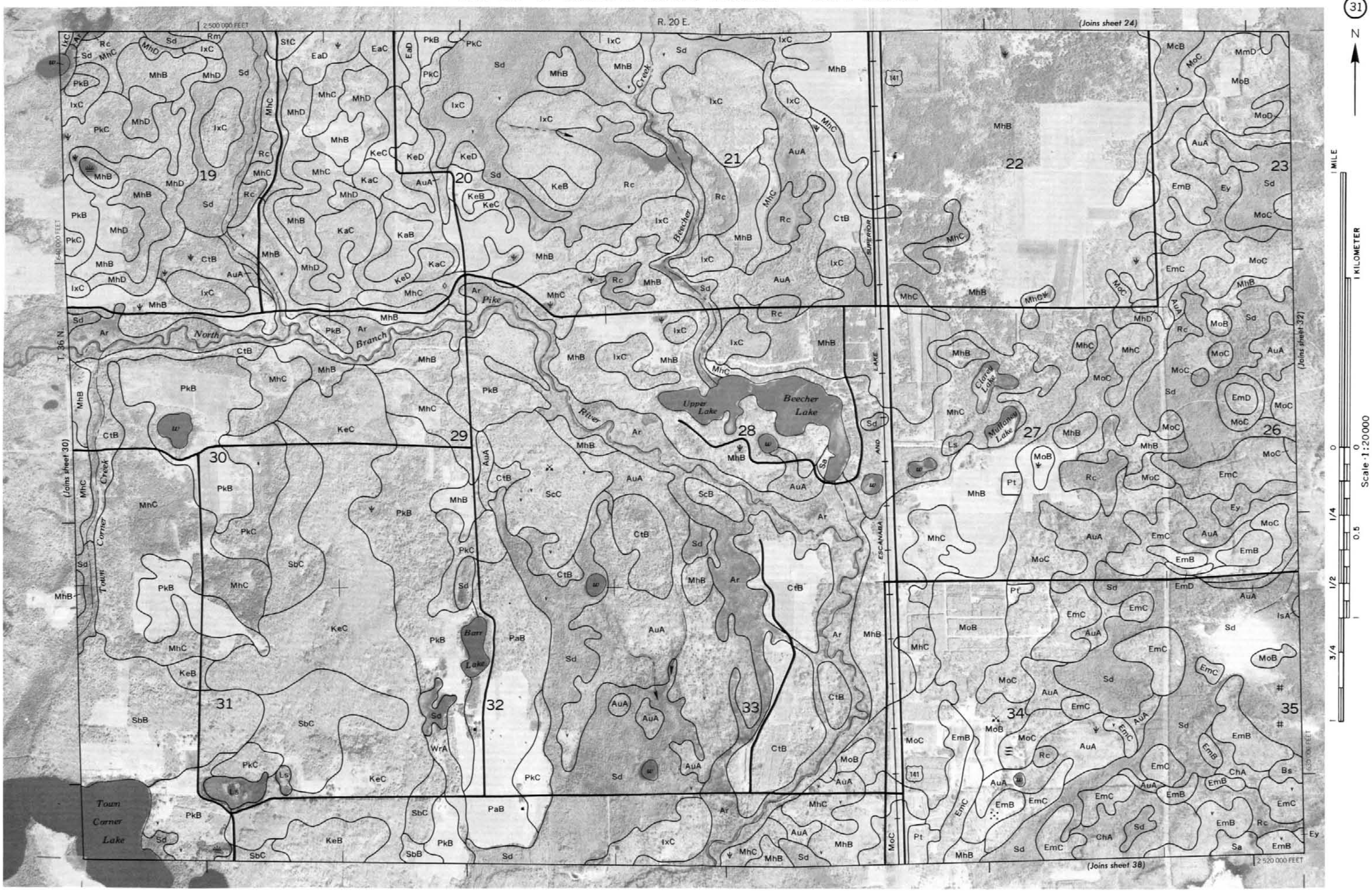



28
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 21)
(Joins sheet 27)
(Joins sheet 29)
(Joins sheet 35)
R. 17 E.
R. 18 E.
T. 36 N.
D'Amour Lake
Vic Lake
Round Lake
Crooked Lake
Brock Pond
Mirror Lake
Pike River
South Branch
Little Harvey Creek
Camp F Creek
Harvey Creek
Avery Creek


29
N
R. 18 E. | R. 19 E.
2 455 000 FEET
(Joins sheet 22)
(Joins sheet 28)
(Joins sheet 30)
(Joins sheet 36)
2 470 000 FEET
T. 36 N.
South Branch Pike River
Whiskey Creek
1 MILE
1 KILOMETER
Scale 1:20 000

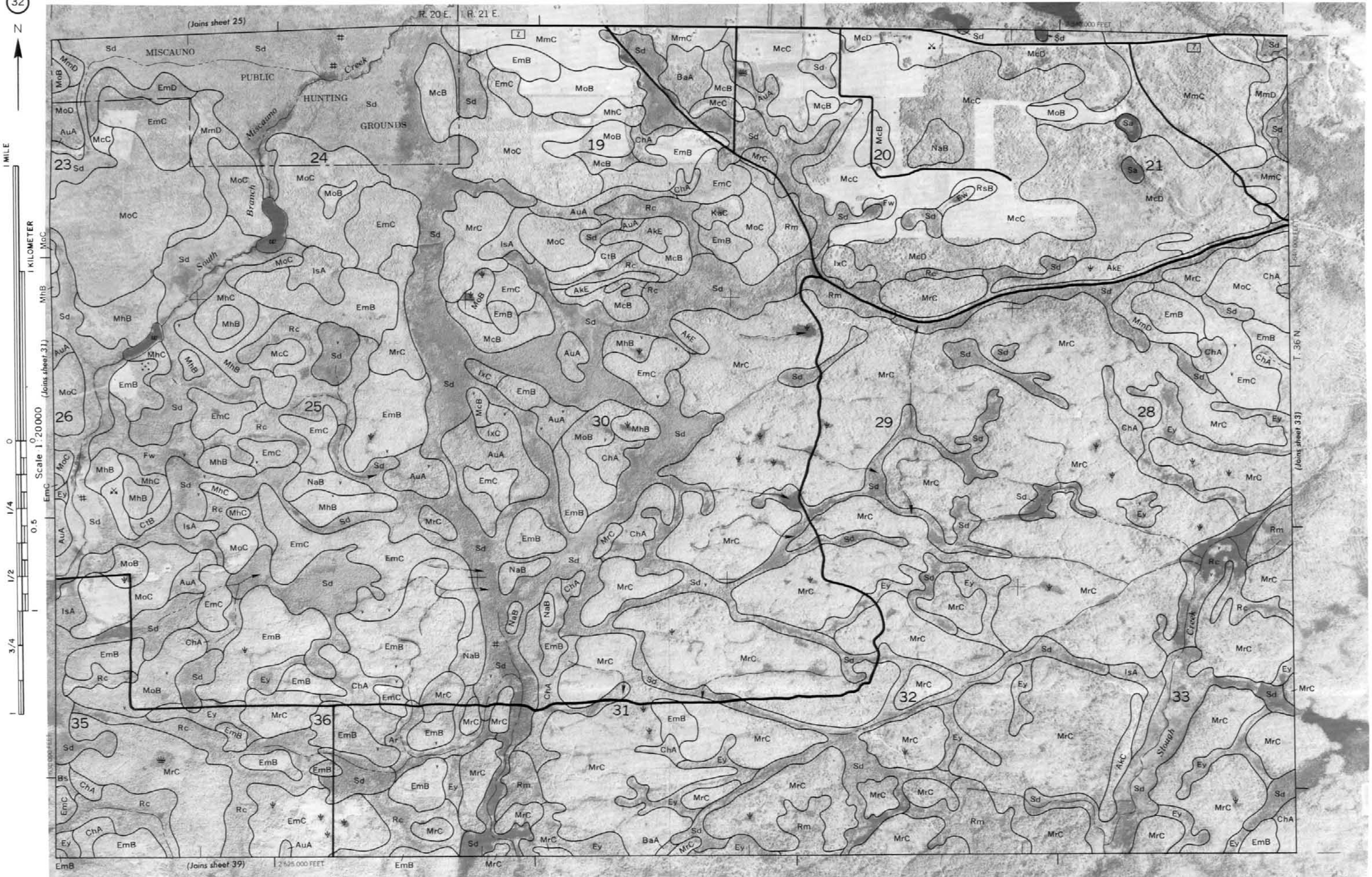

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 23)
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 37)
R. 19 E.
T. 36 N.
2 490 000 FEET
2 475 000 FEET
640 000 FEET
Twelve Foot Falls County Park
North Branch
Whiskey Creek
Pike River
Christian Lake
Camp Lake
Phillips Lake
McDonald Lake
Merriman Lake
Town Corner Lake
Town Corner Creek
South Branch Pike River
water
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 31

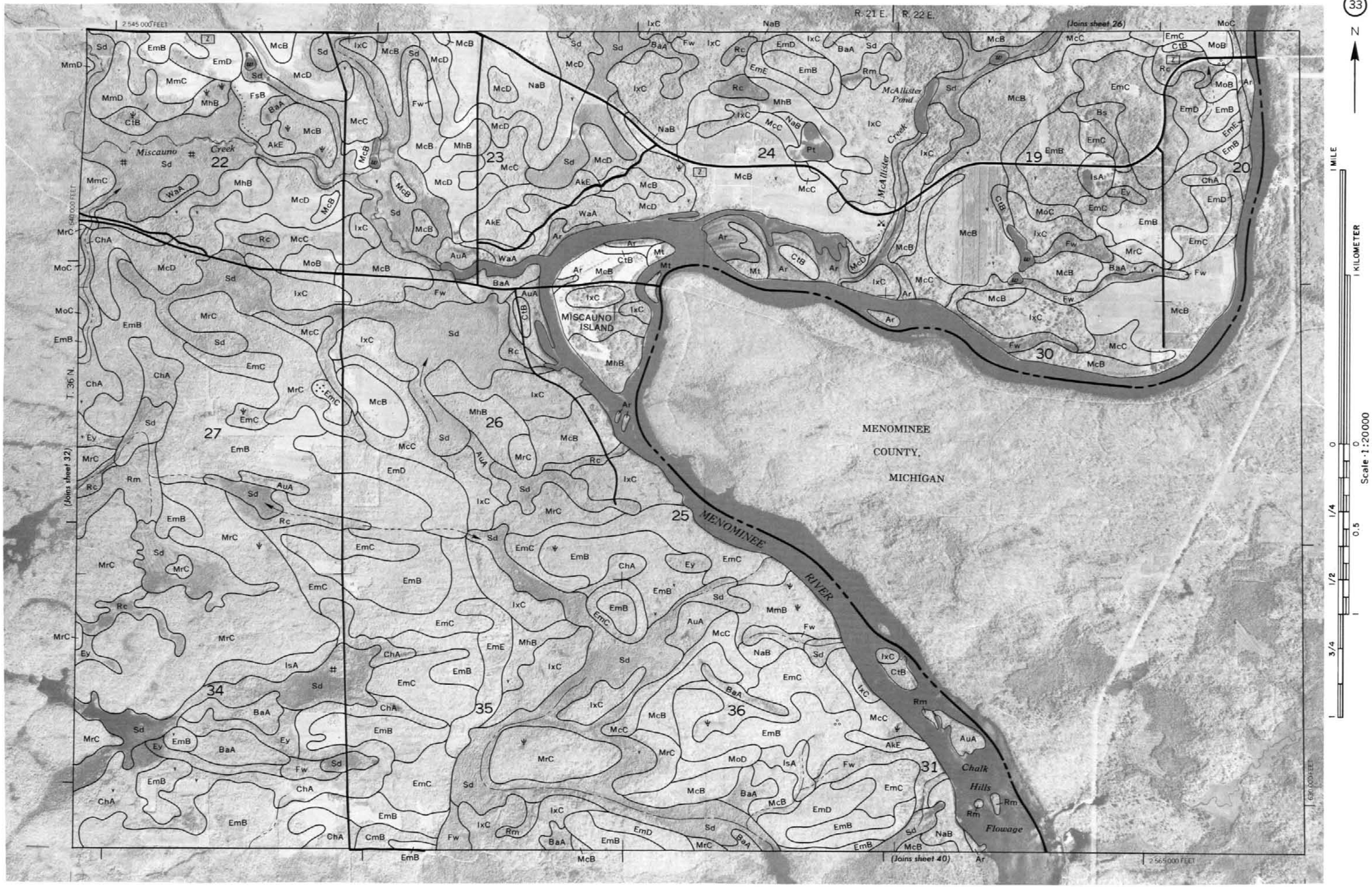


(32)

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 32

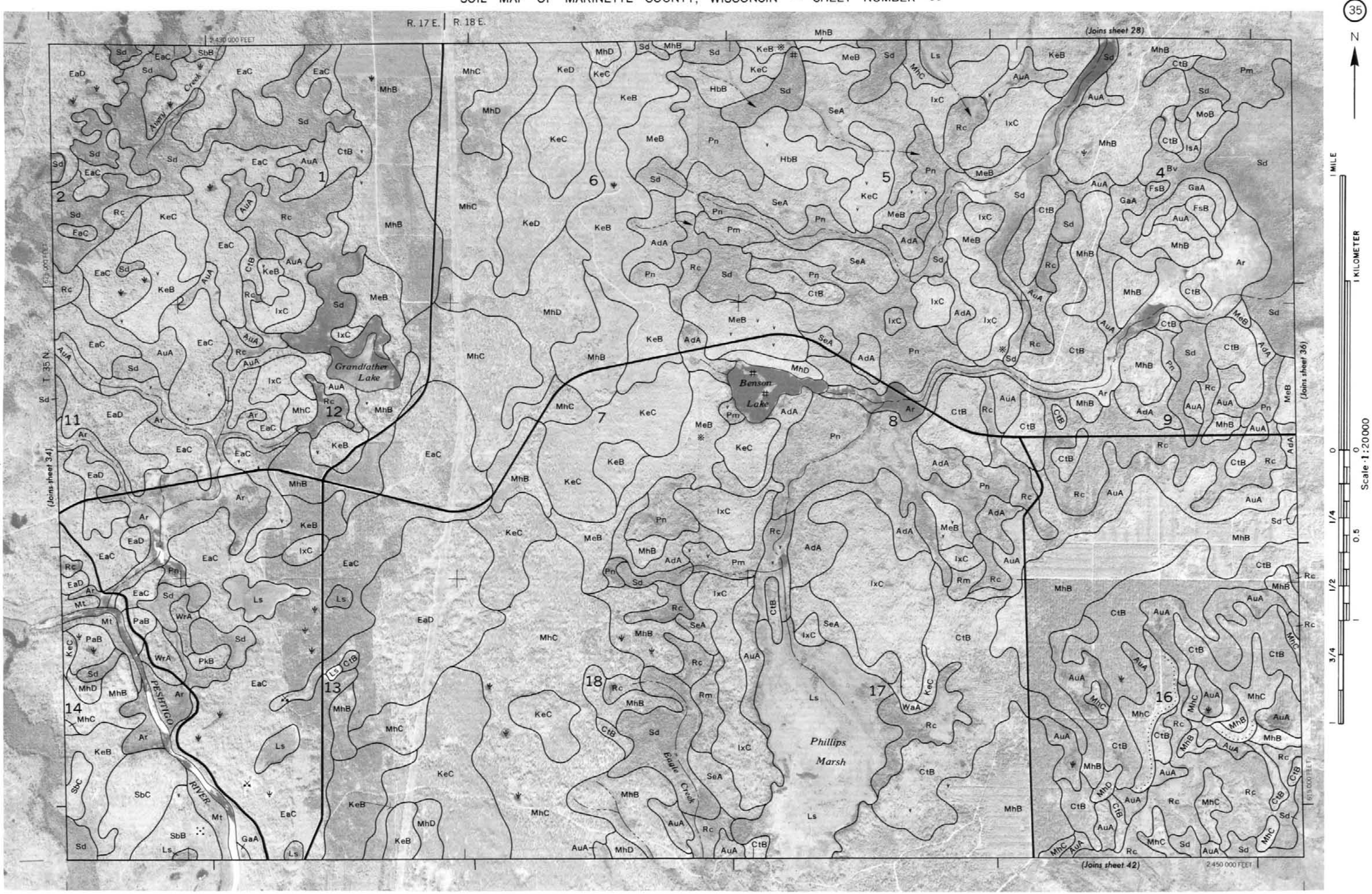


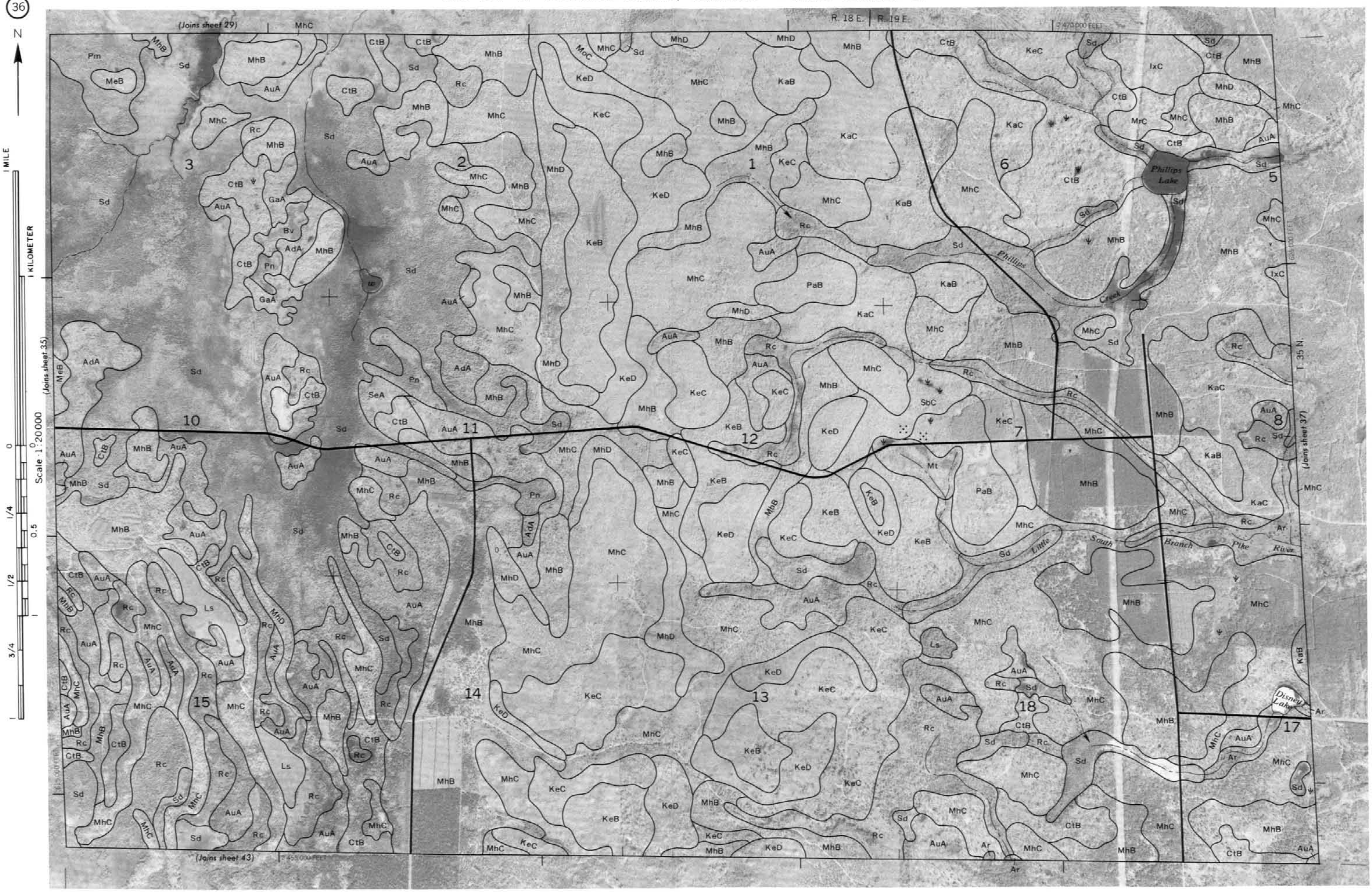
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 33

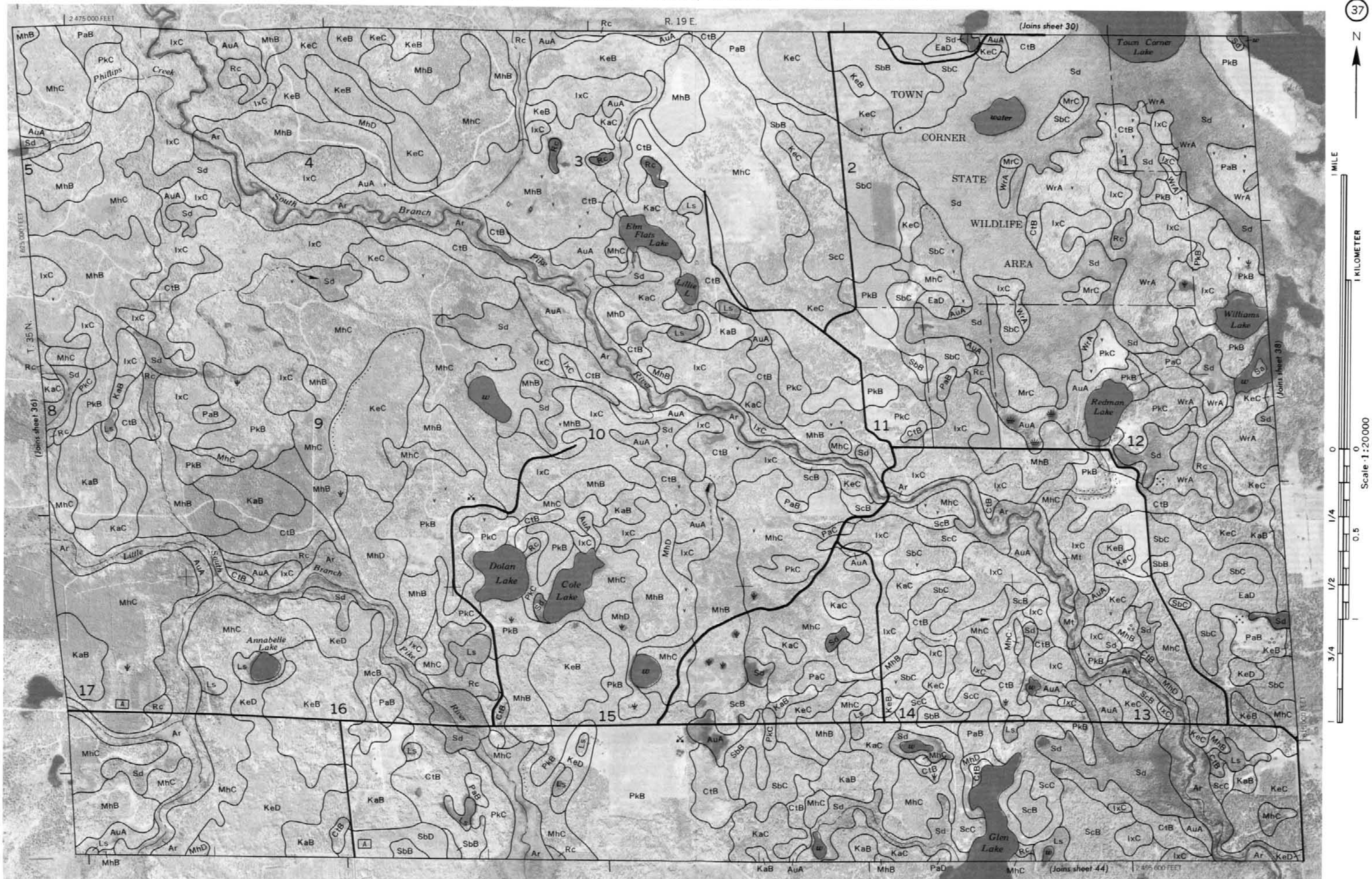



34
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
1
FOREST COUNTY
(Joins sheet 27)
R. 17 E.
2 425 000 FEET
T. 35 N.
(Joins sheet 35)
(Joins sheet 41)
2 405 000 FEET
PESHTIGO RIVER
Goodman
County Park
John Creek
Swede
water

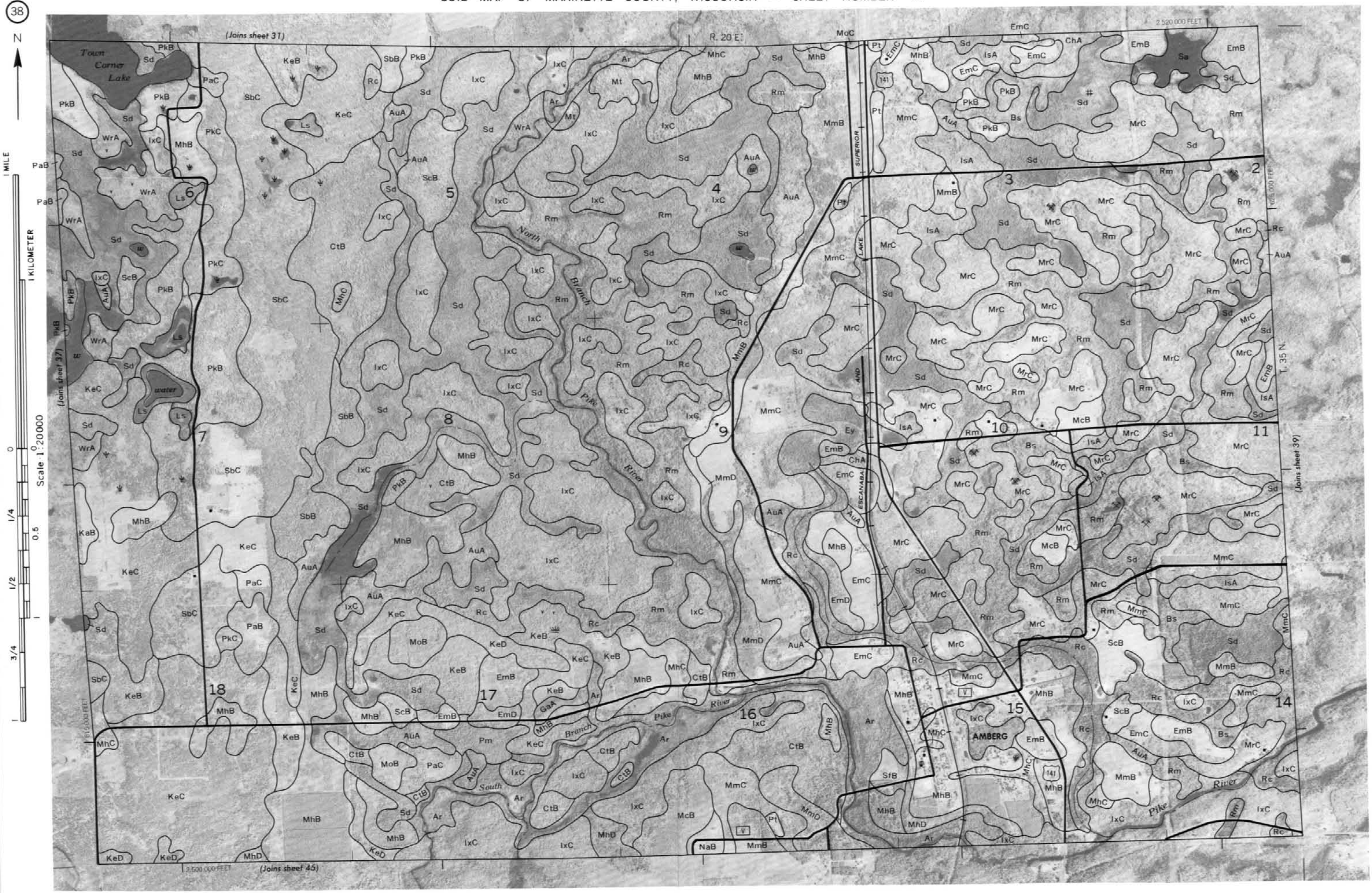
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 35



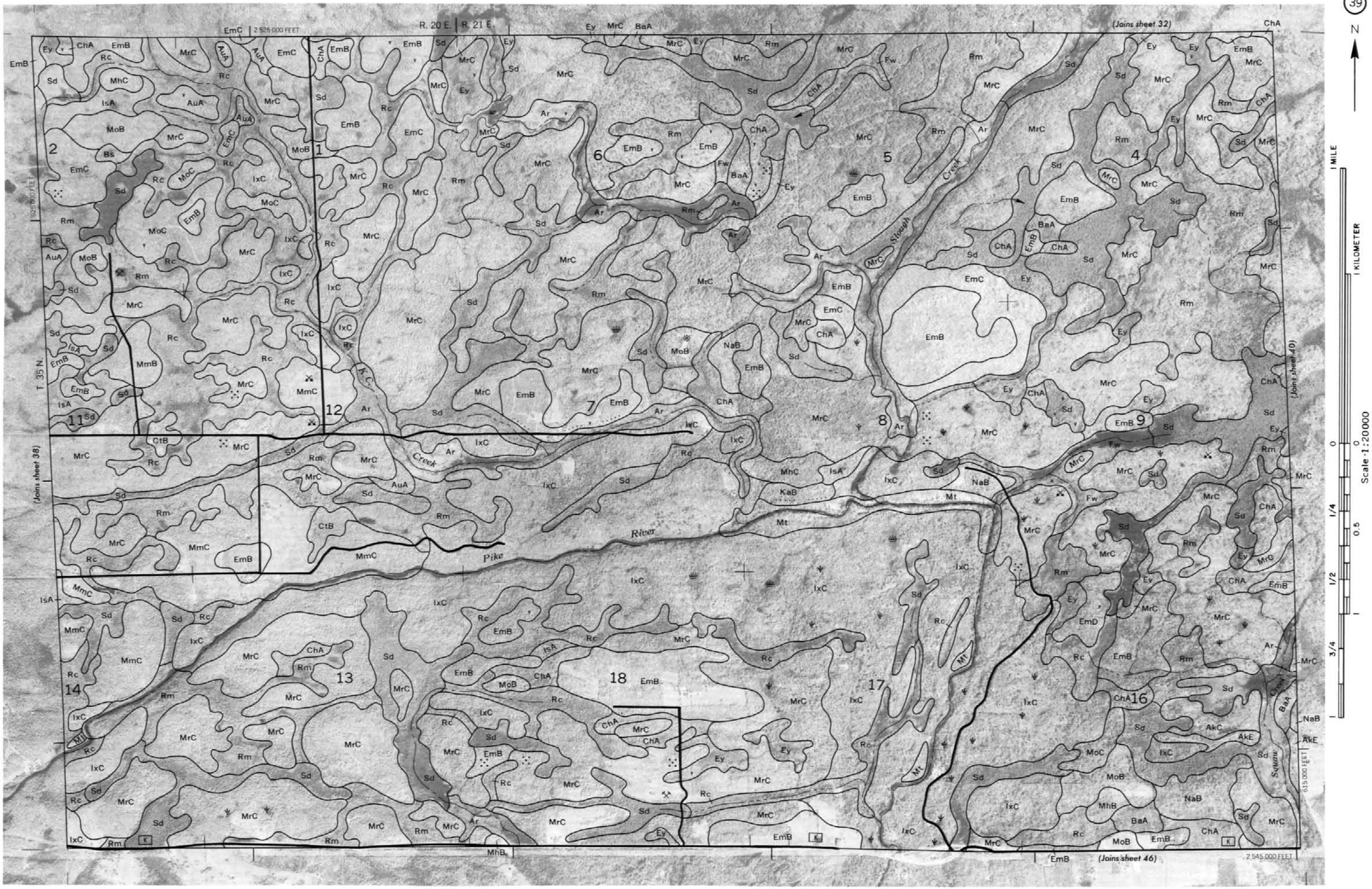

36
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 29)
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 43)
R. 18 E. | R. 19 E.
T. 35 N.
Phillips Lake
Phillips Creek
Disney Lake
South Branch Pike River
Little
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18

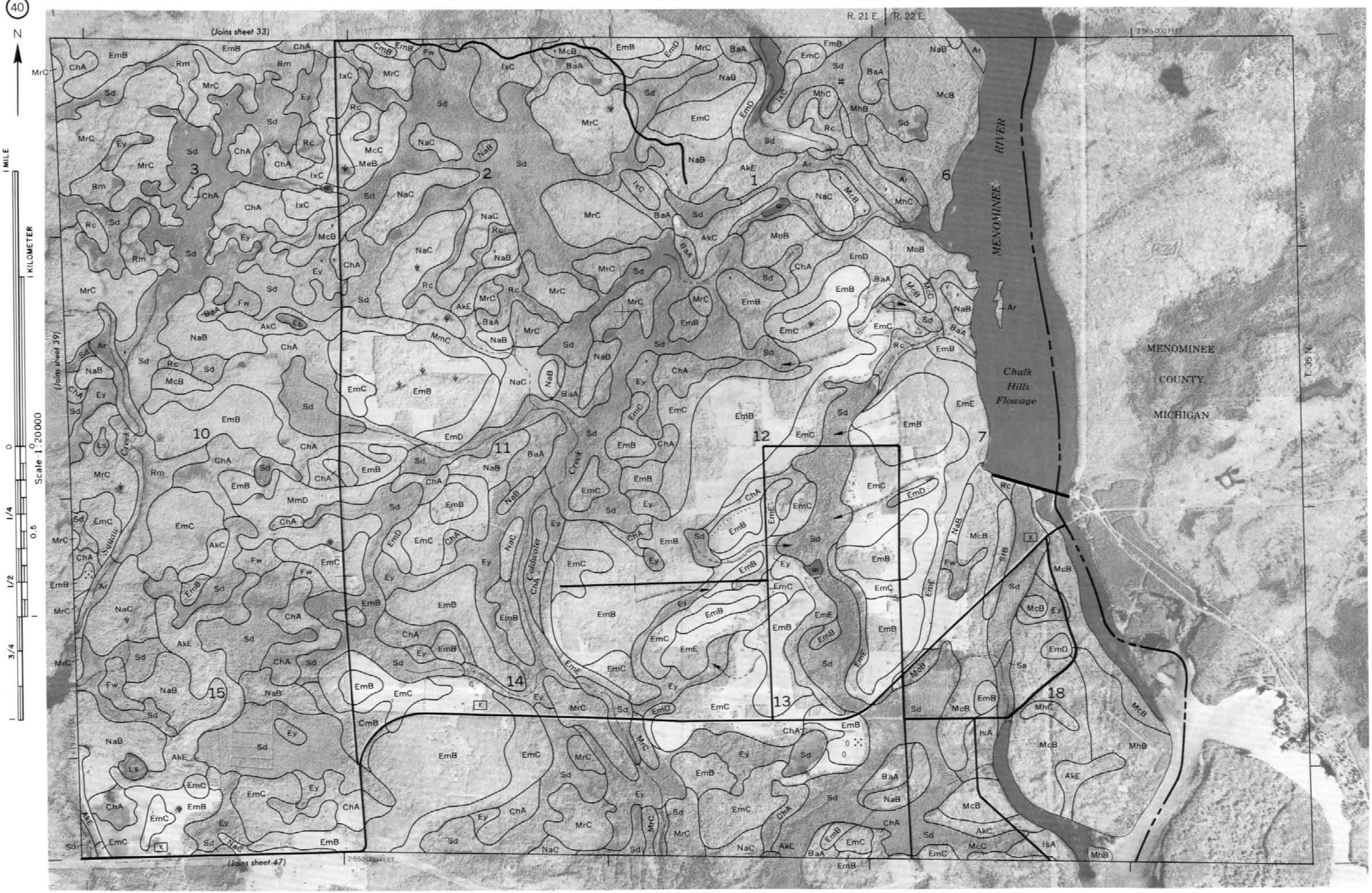

37
N
R. 19 E.
T. 35 N.
(Joins sheet 30)
(Joins sheet 36)
(Joins sheet 38)
(Joins sheet 44)
2 475 000 FEET
625 000 FEET
TOWN CORNER STATE WILDLIFE AREA
Town Corner Lake
water
Williams Lake
Redman Lake
Elm Flats Lake
Little L.
Dolan Lake
Cole Lake
Annabelle Lake
Glen Lake
Phillips Creek
South Branch Pike River
Little South Branch
Pike River
1 MILE
1 KILOMETER
Scale 1:20000

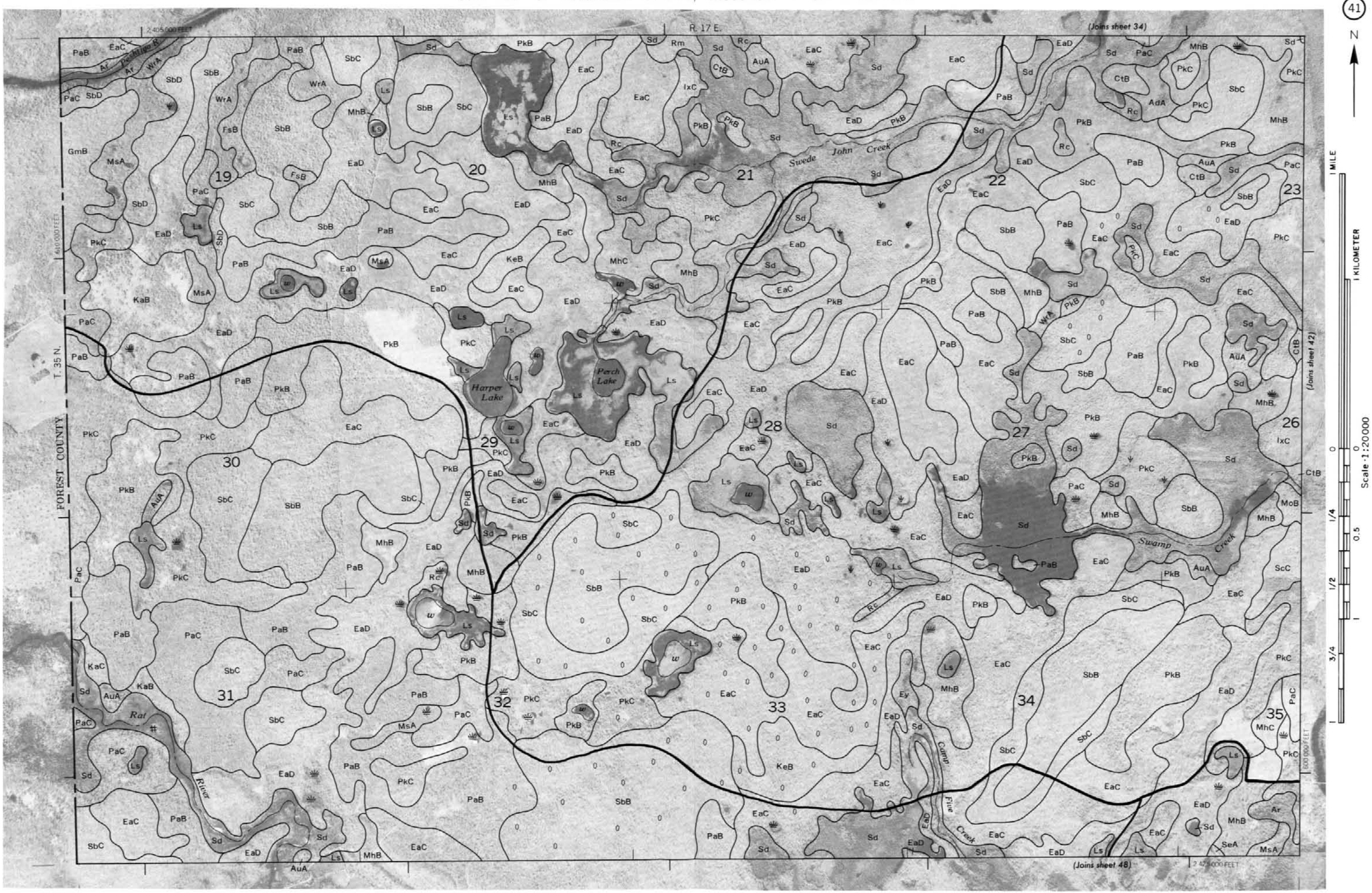
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 38

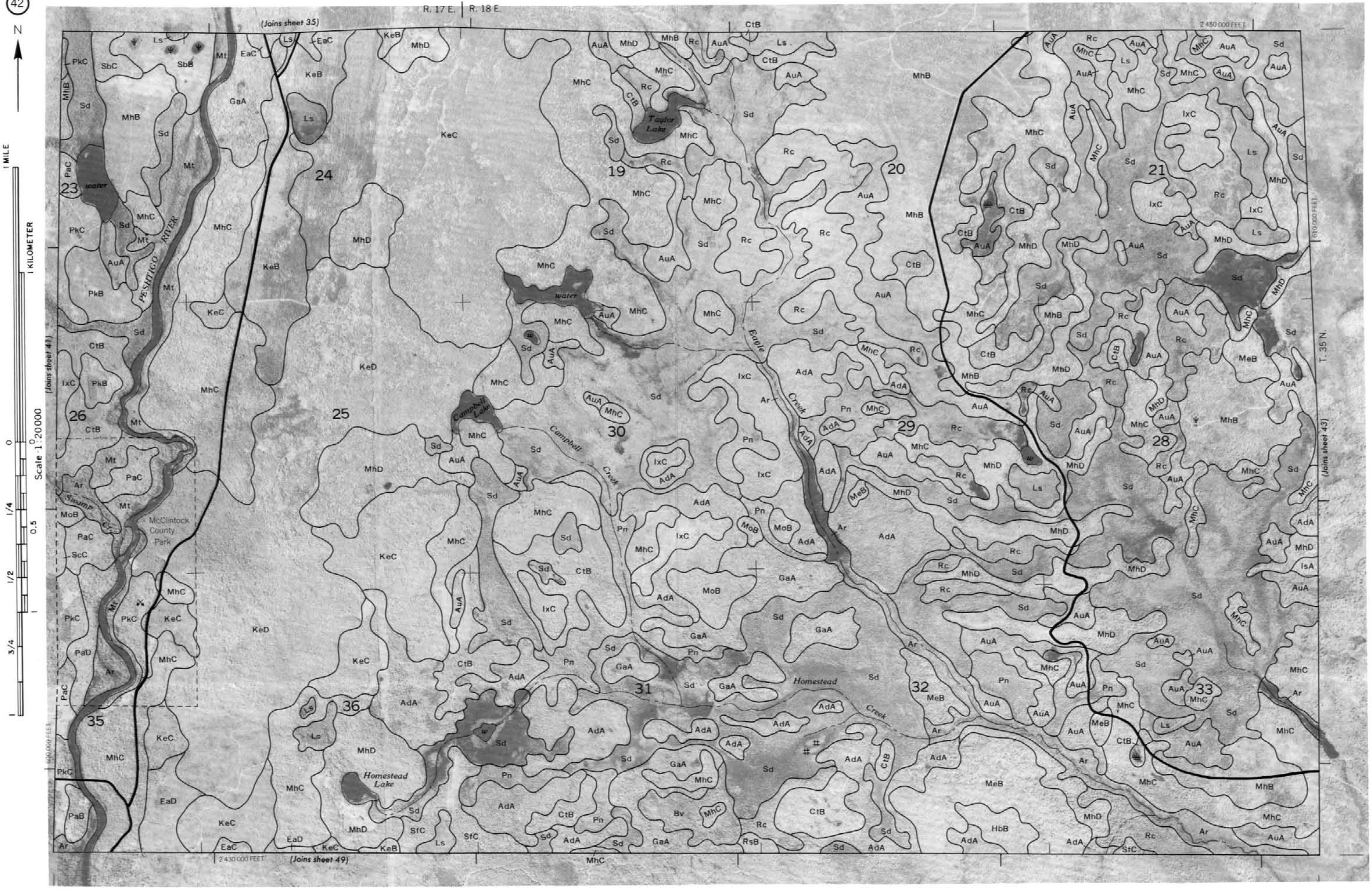


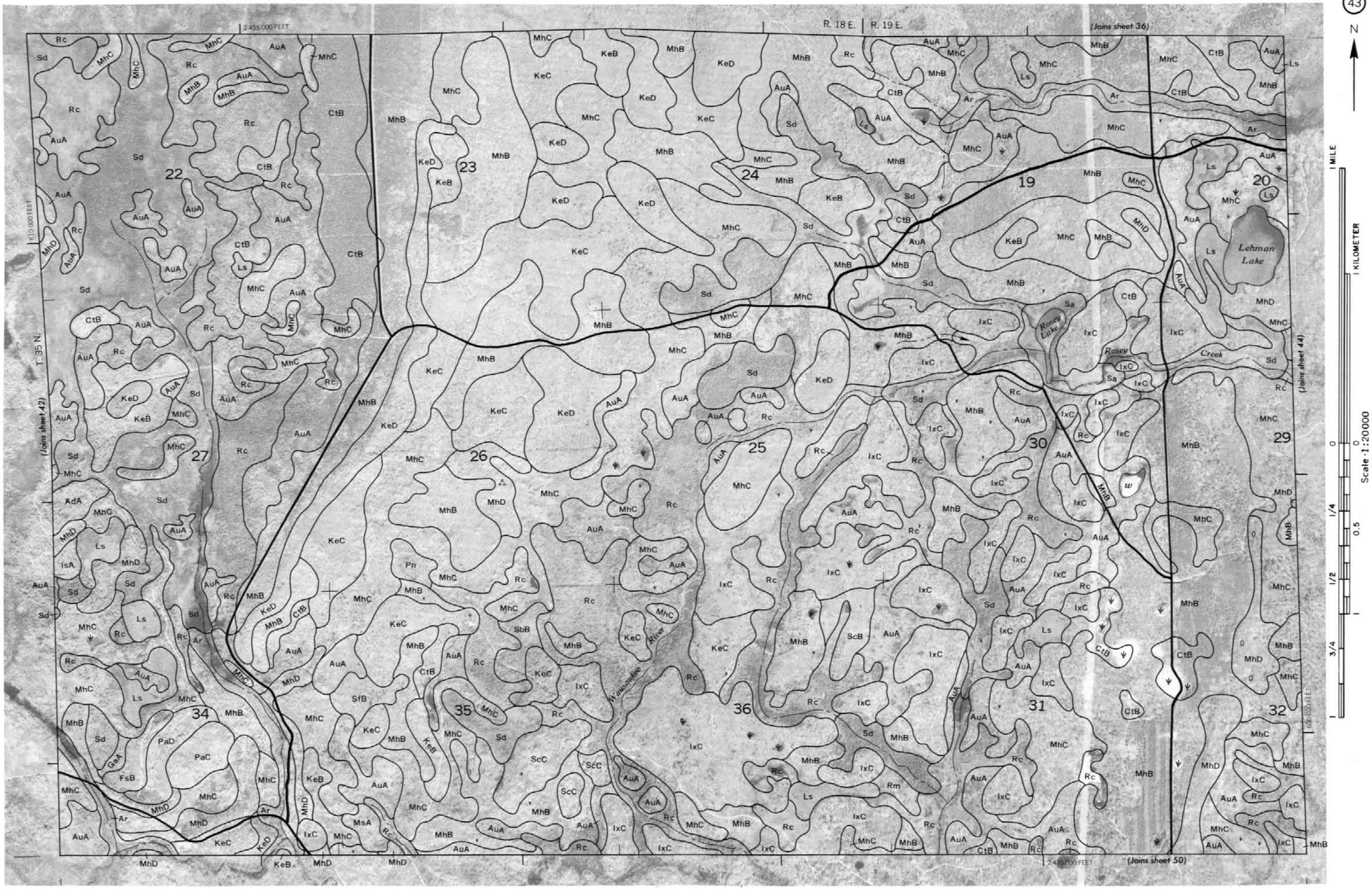
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 39




N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 33)
(Joins sheet 39)
(Joins sheet 47)
R. 21 E.
R. 22 E.
T. 35 N.
2 565 000 FEET
2 550 000 FEET
MENOMINEE RIVER
Chalk Hills Flowage
MENOMINEE COUNTY, MICHIGAN
Squaw Creek
Coldwater Creek

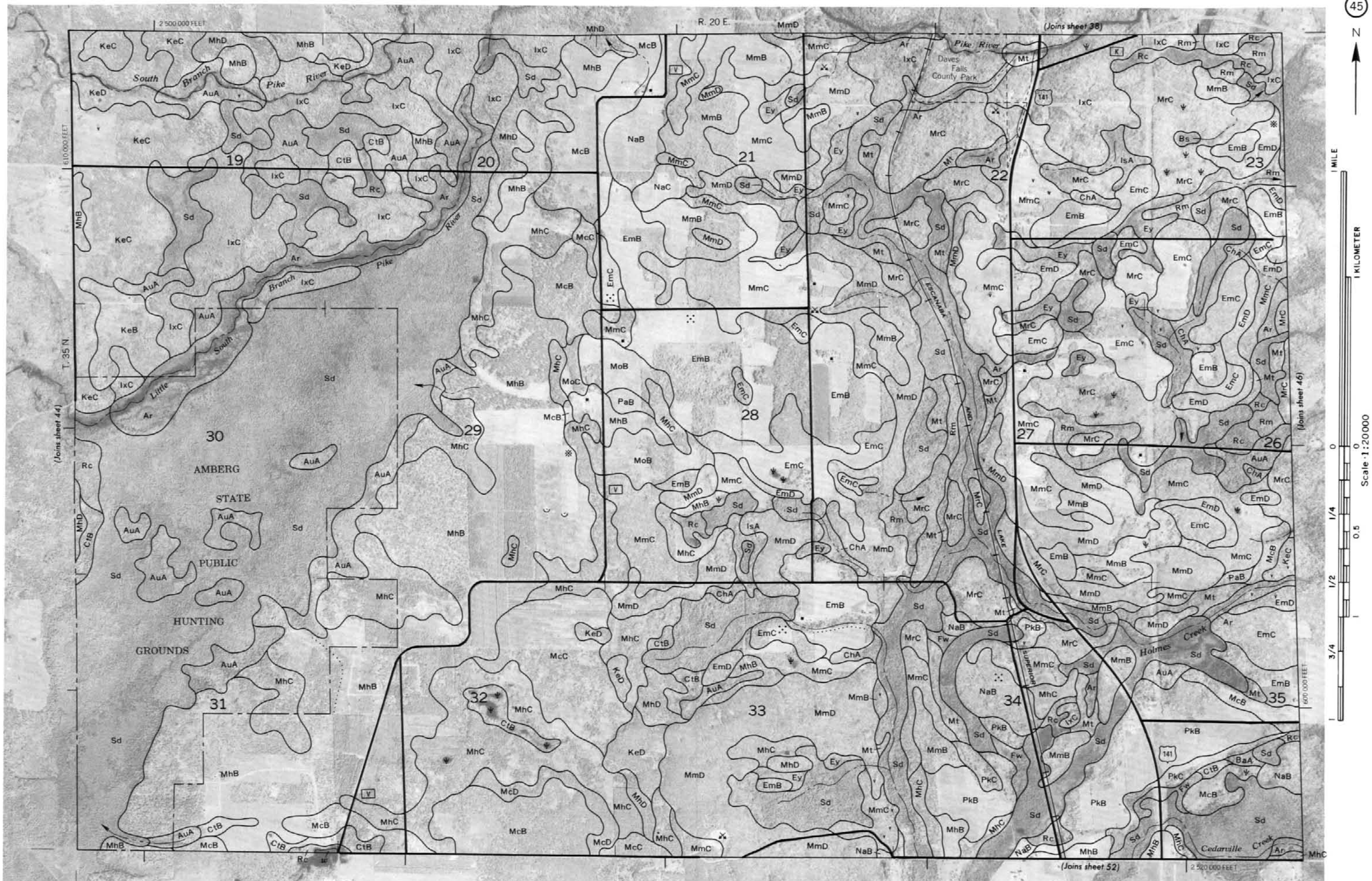

41
N
(Joins sheet 34)
R. 17 E.
2 405 000 FEET
T. 35 N.
FOREST COUNTY
(Joins sheet 42)
(Joins sheet 48)
2 425 000 FEET
Peshtigo R.
Swede John Creek
Harper Lake
Perch Lake
Swamp Creek
Rat River
Camp Five Creek
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
1 MILE
1 KILOMETER
Scale 1:20000


42
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
R. 17 E.
R. 18 E.
(Joins sheet 35)
(Joins sheet 41)
(Joins sheet 43)
(Joins sheet 49)
T. 35 N.
2 450 000 FEET
2 430 000 FEET
Taylor Lake
Campbell Lake
Homestead Lake
water
PESHTIGO RIVER
Eagle Creek
Campbell Creek
Homestead Creek
Swamp Cr.
McClintock County Park
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36

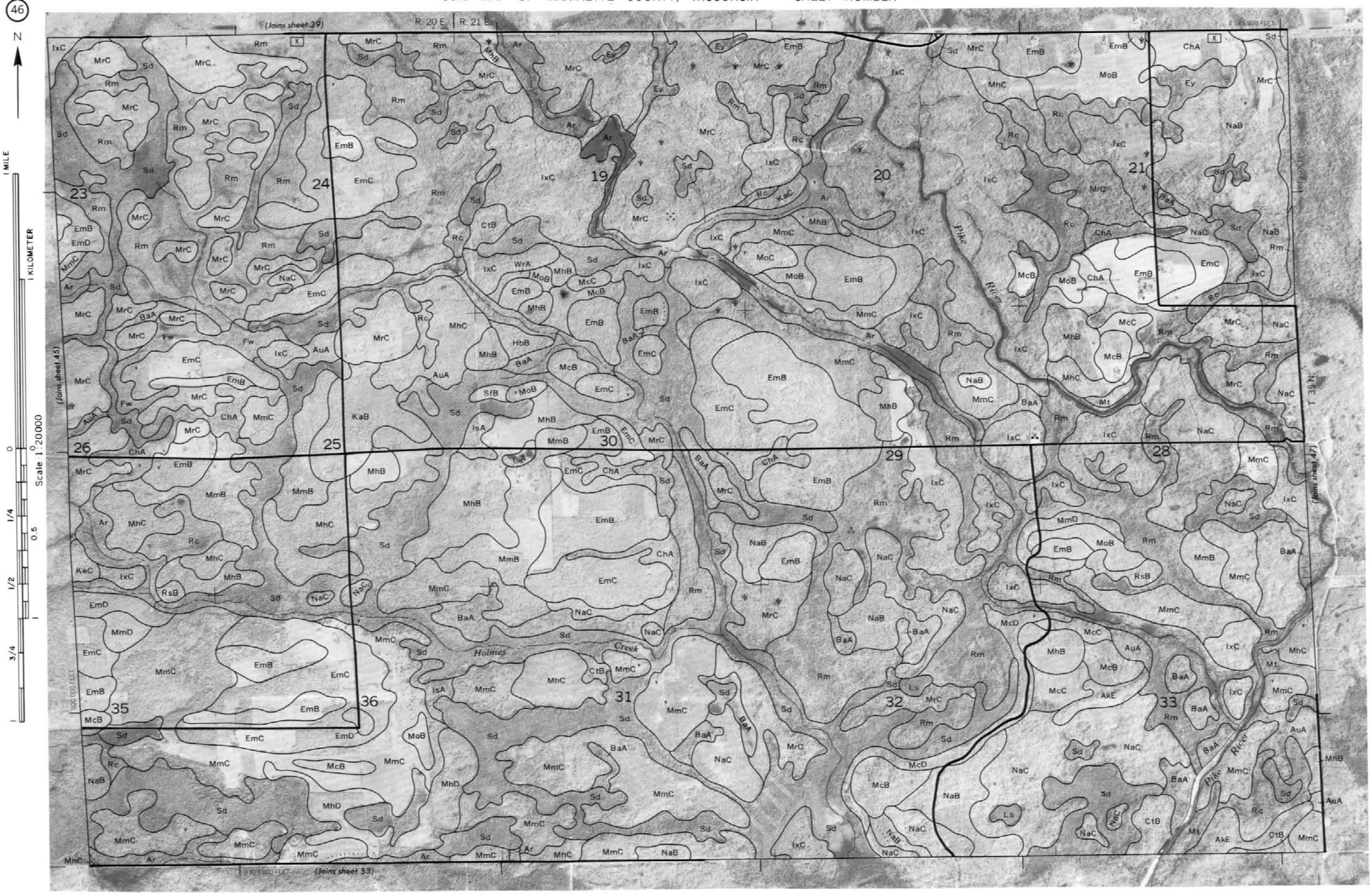

43
N
(Joins sheet 36)
(Joins sheet 42)
(Joins sheet 44)
(Joins sheet 50)
R. 18 E.
R. 19 E.
T. 35 N.
2 455 000 FEET
2 410 000 FEET
Lehman Lake
Rosey Lake
Rosey Creek
Wausaukee River
1 MILE
1 KILOMETER
Scale 1:20000

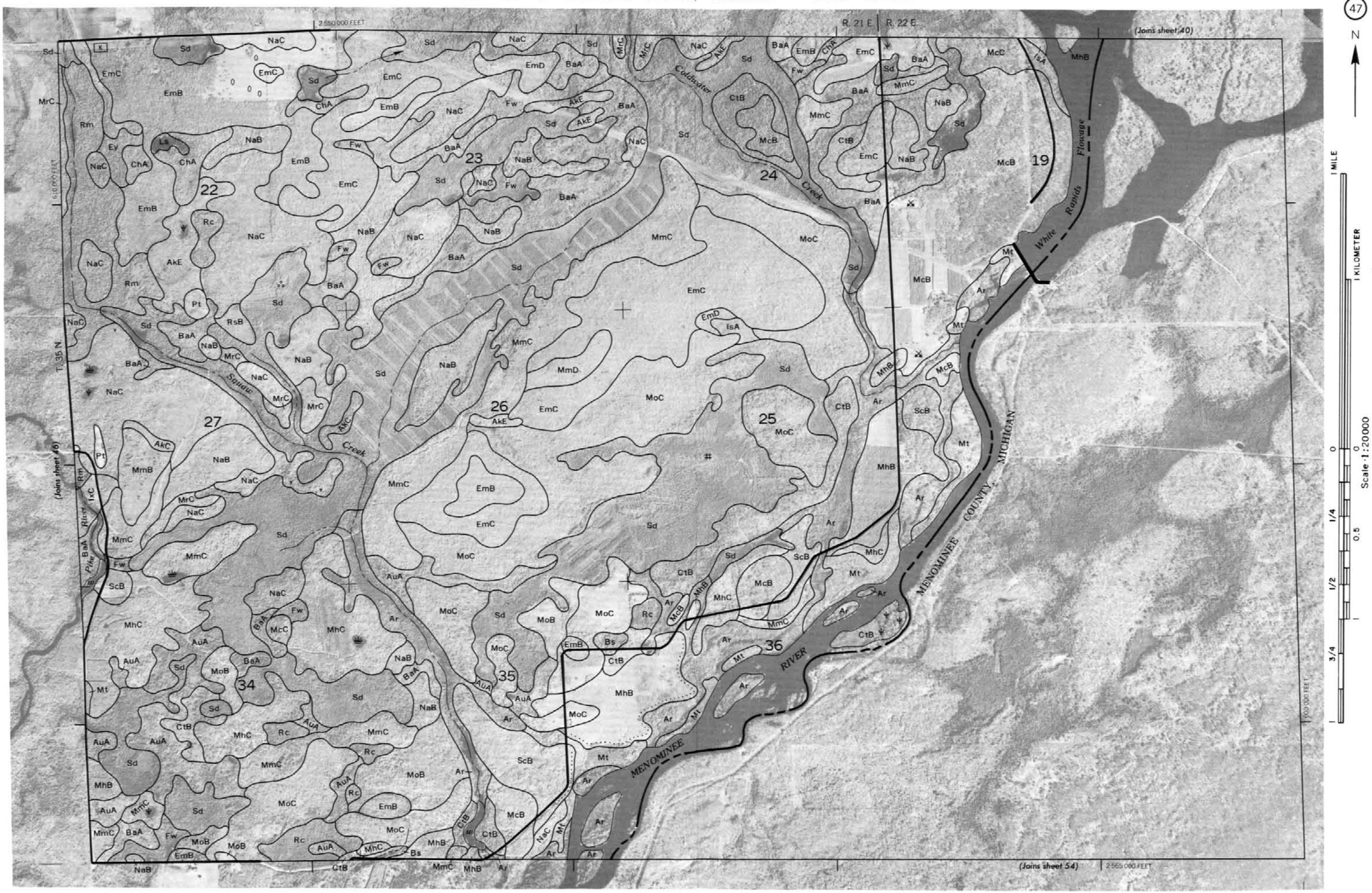
(44)

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 44

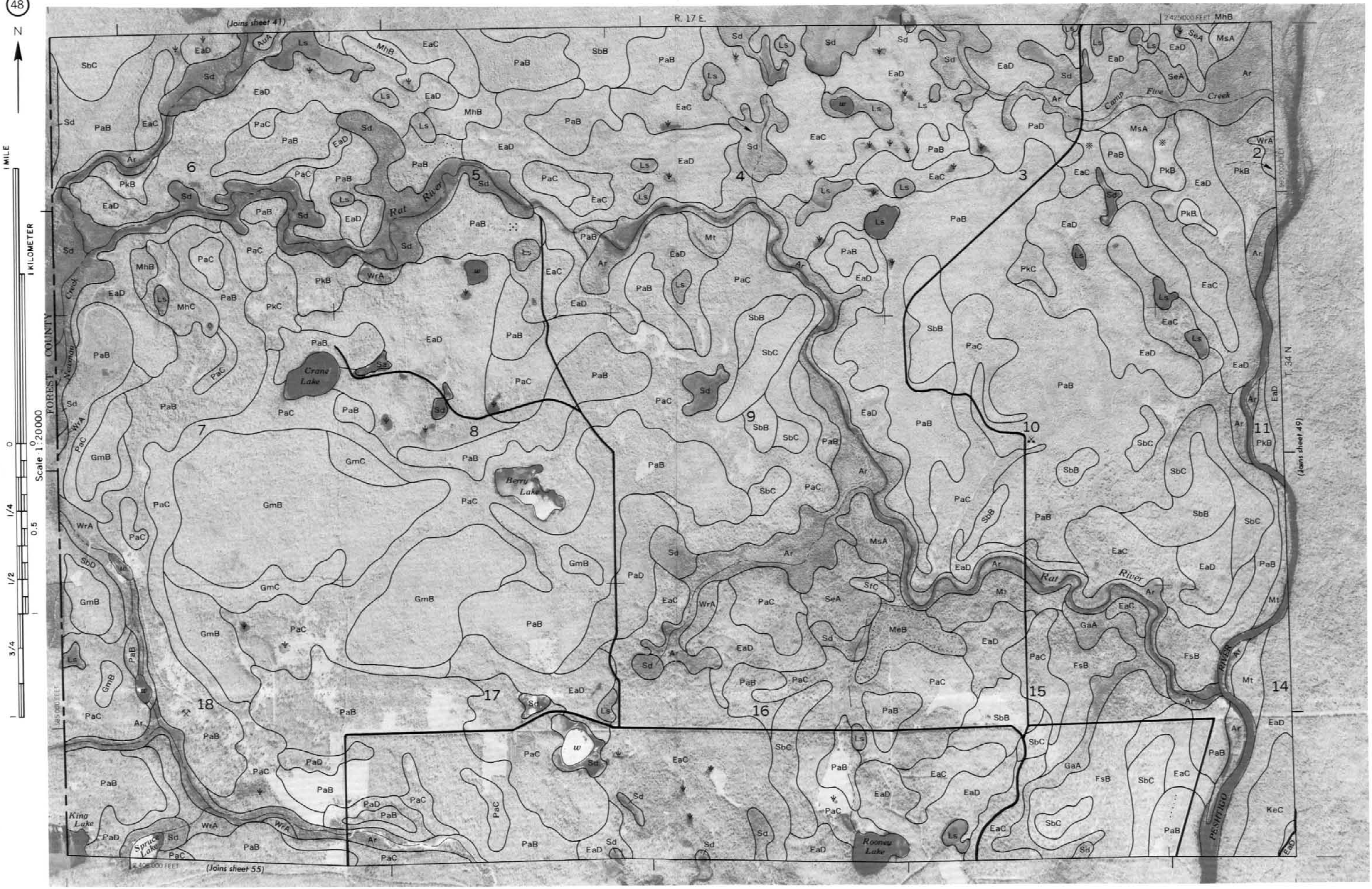

45
N
R. 20 E.
T. 35 N.
(Joins sheet 38)
(Joins sheet 44)
(Joins sheet 46)
(Joins sheet 52)
2 500 000 FEET
2 520 000 FEET
610 000 FEET
600 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
South Branch Pike River
Little South Branch Pike River
Pike River
Daves Falls County Park
ESCANABA AND LAKE SUPERIOR
Holmes Creek
Cedarville Creek
AMBERG STATE PUBLIC HUNTING GROUNDS

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 46

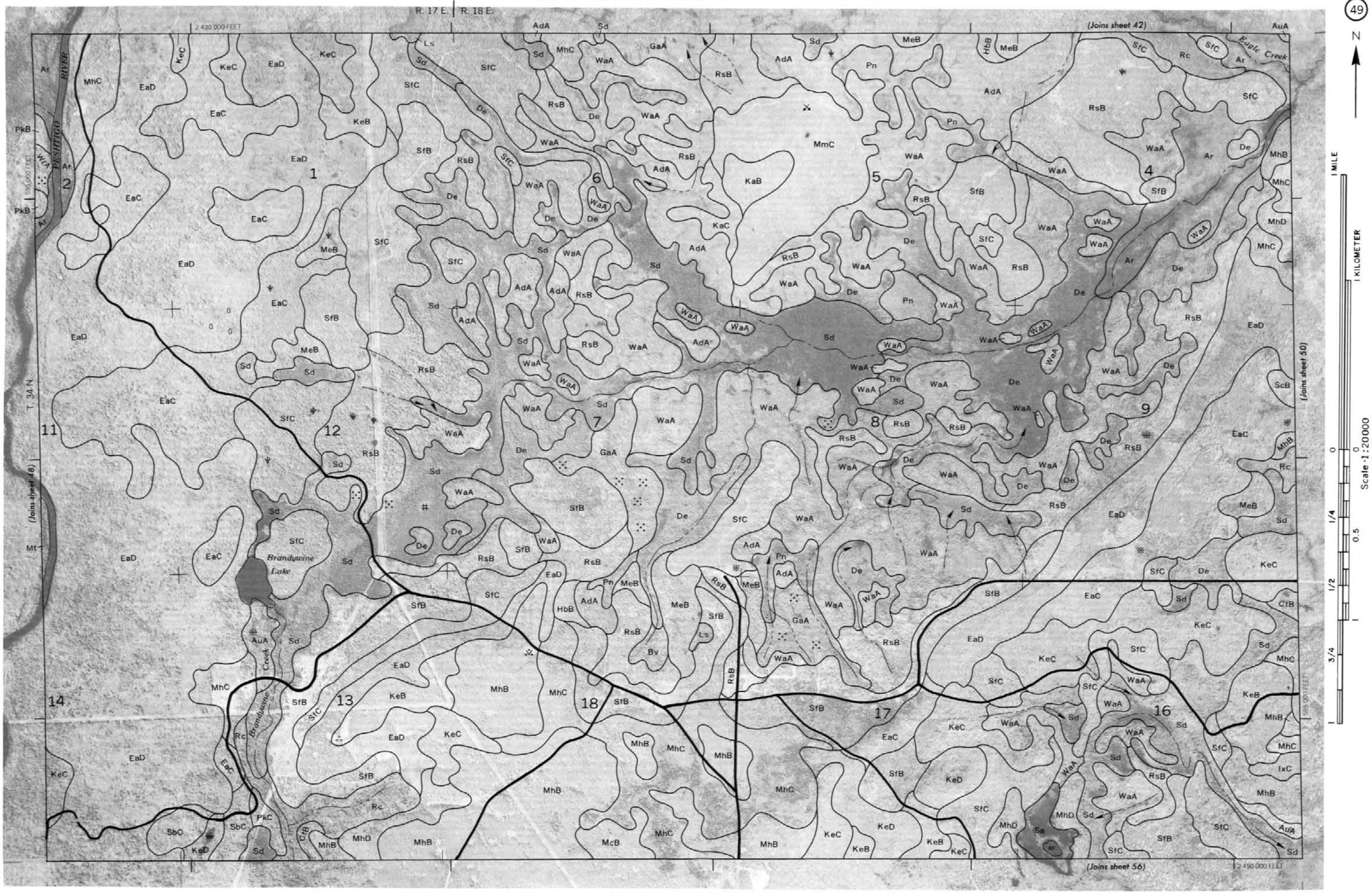



47
N
(Joins sheet 40)
(Joins sheet 46)
(Joins sheet 54)
2 550 000 FEET
2 565 000 FEET
R. 21 E. R. 22 E.
T. 35 N.
Coldwater Creek
Squaw Creek
Pike River
White Rapids Flowage
MENOMINEE RIVER
MENOMINEE COUNTY, MICHIGAN
22
23
24
19
25
26
27
34
35
36
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

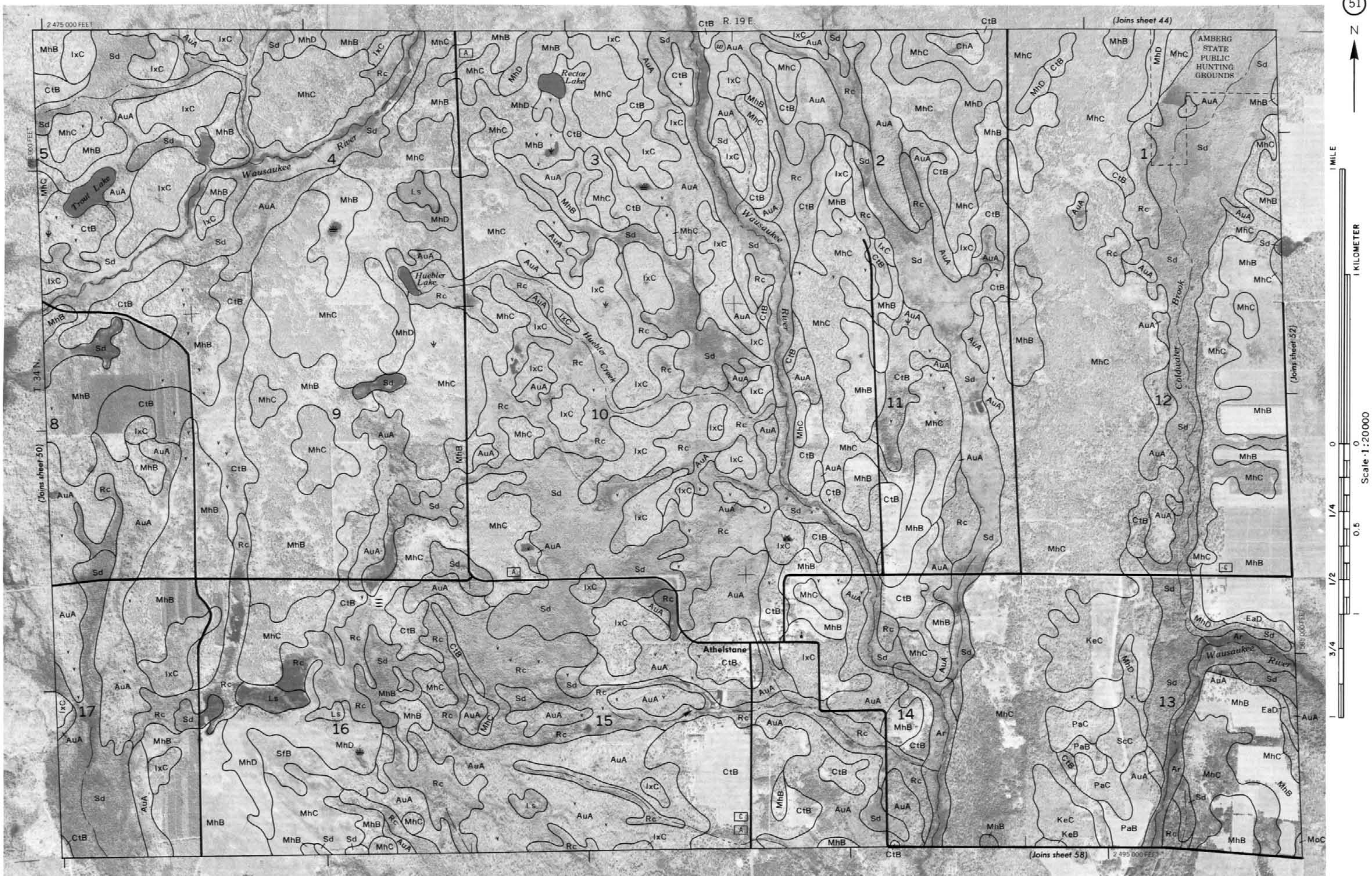
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 48

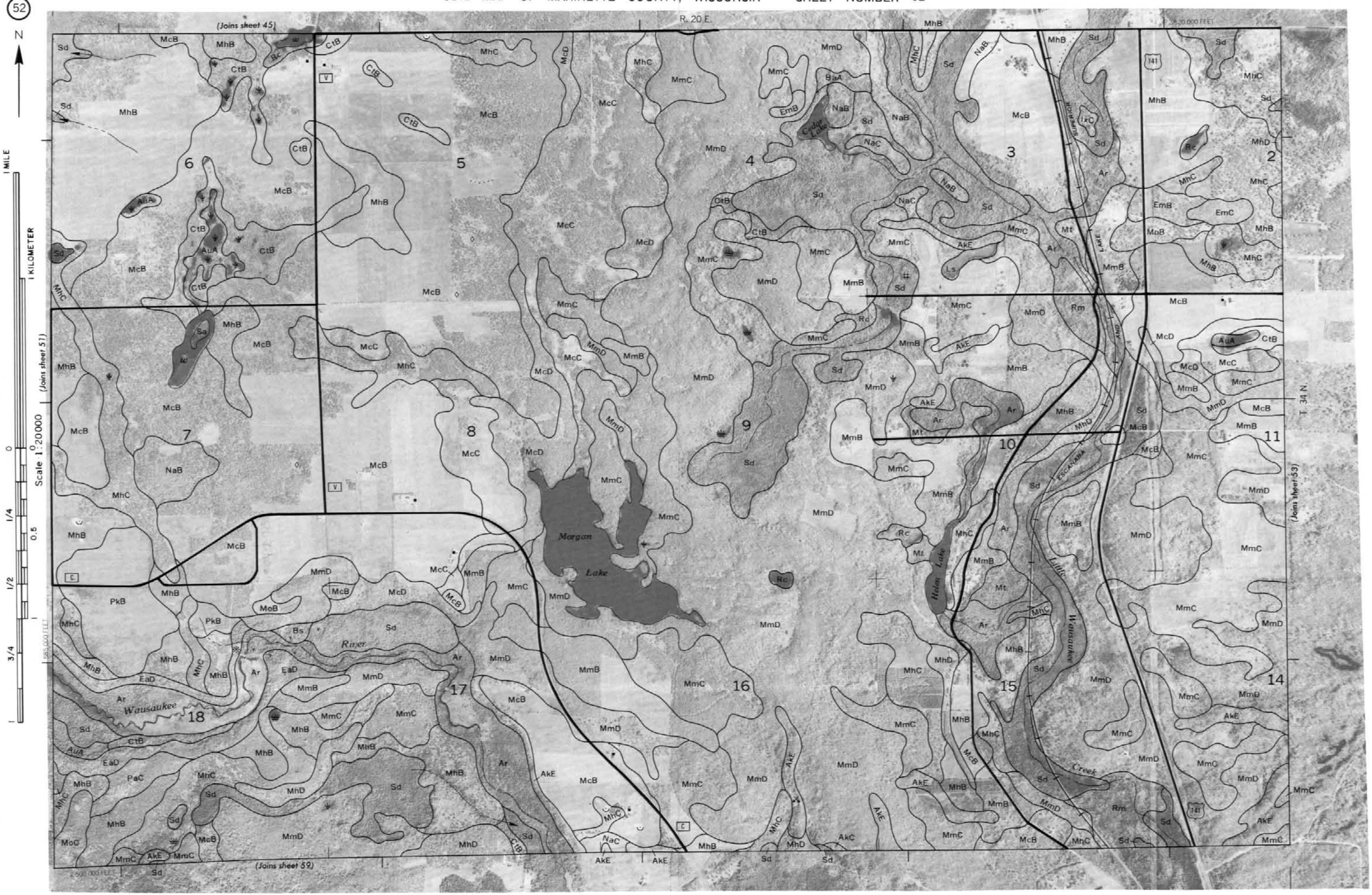


SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 49



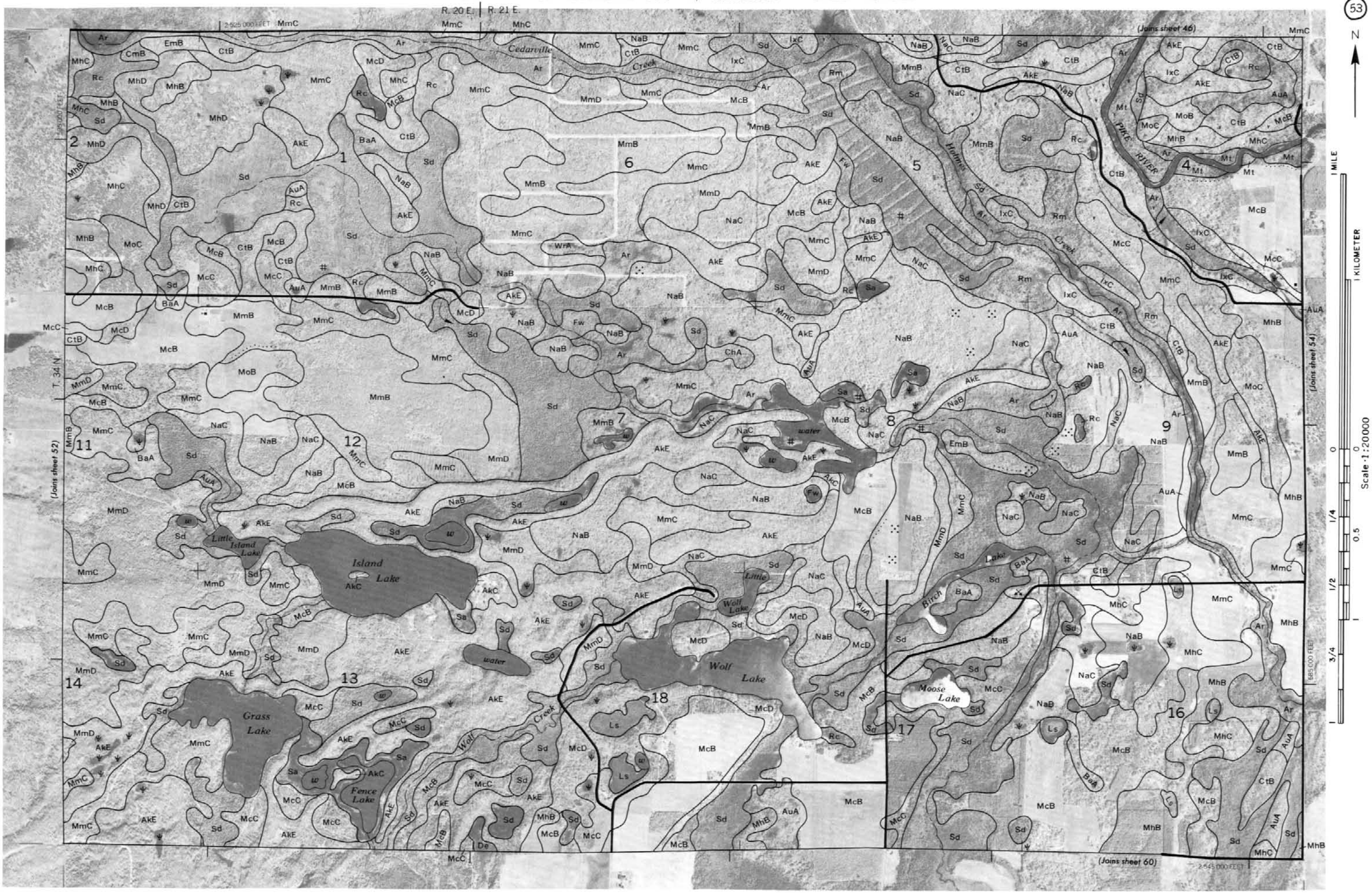

N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 43)
(Joins sheet 49)
(Joins sheet 51)
(Joins sheet 57)
R. 18 E.
R. 19 E.
T. 34 N.
Eagle Creek
Wausaukee River
Spring Lake
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18


51
N
(Joins sheet 44)
(Joins sheet 52)
(Joins sheet 50)
(Joins sheet 58)
R. 19 E.
T. 34 N.
2 475 000 FEET
2 495 000 FEET
AMBERG STATE PUBLIC HUNTING GROUNDS
Trout Lake
Rector Lake
Huebler Lake
Huebler Creek
Wausaukee River
Coldwater Brook
Athelstane
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
1

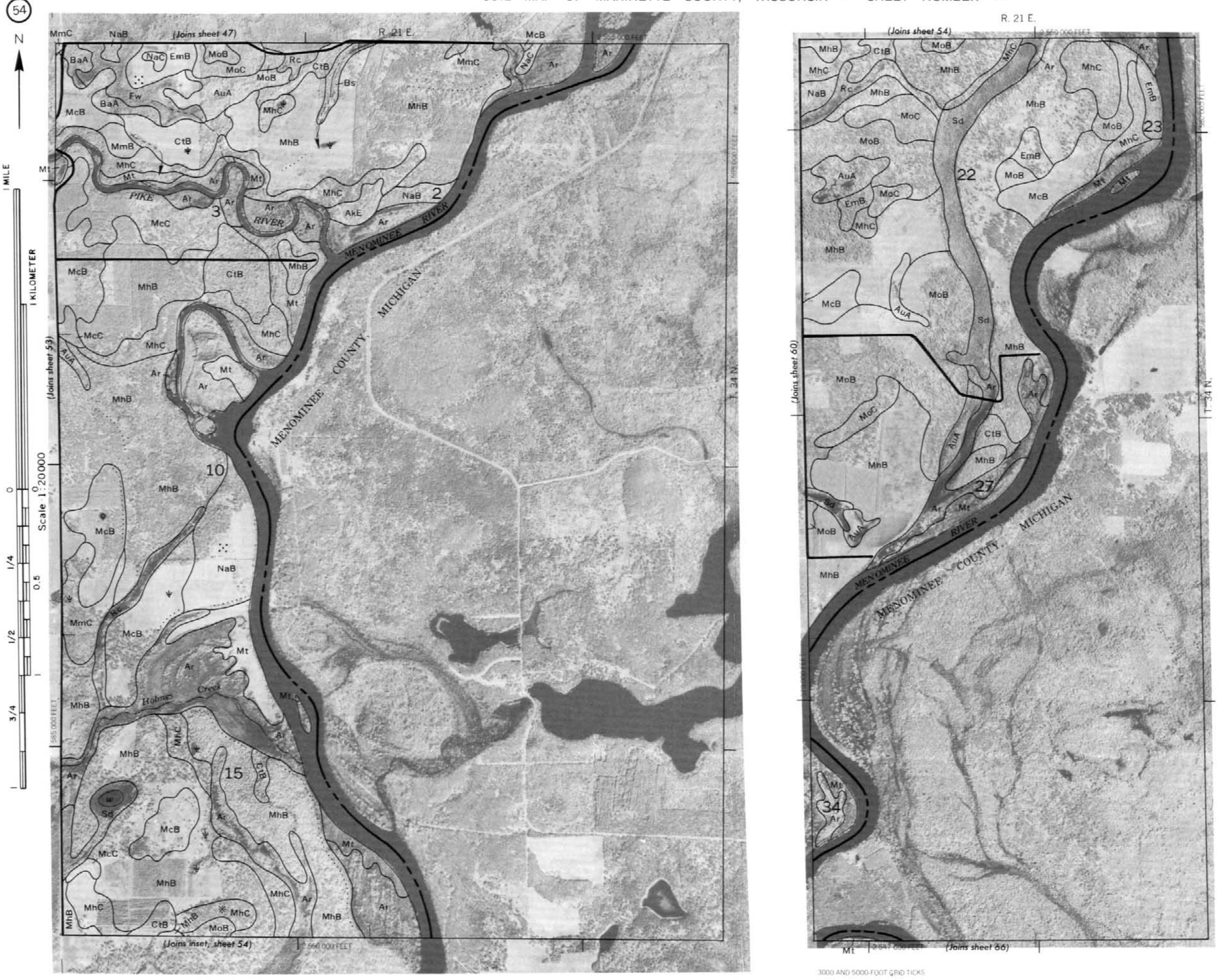

52
N
(Joins sheet 45)
R. 20 E.
(Joins sheet 51)
(Joins sheet 53)
(Joins sheet 59)
T. 34 N.
Scale 1:20000
1 MILE
1 KILOMETER
Morgan
Lake
Cedar Lake
Helen Lake
Wausaukee
River
Little
Wausaukee
Creek
ESCANABA
LAKE
141
1
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 53

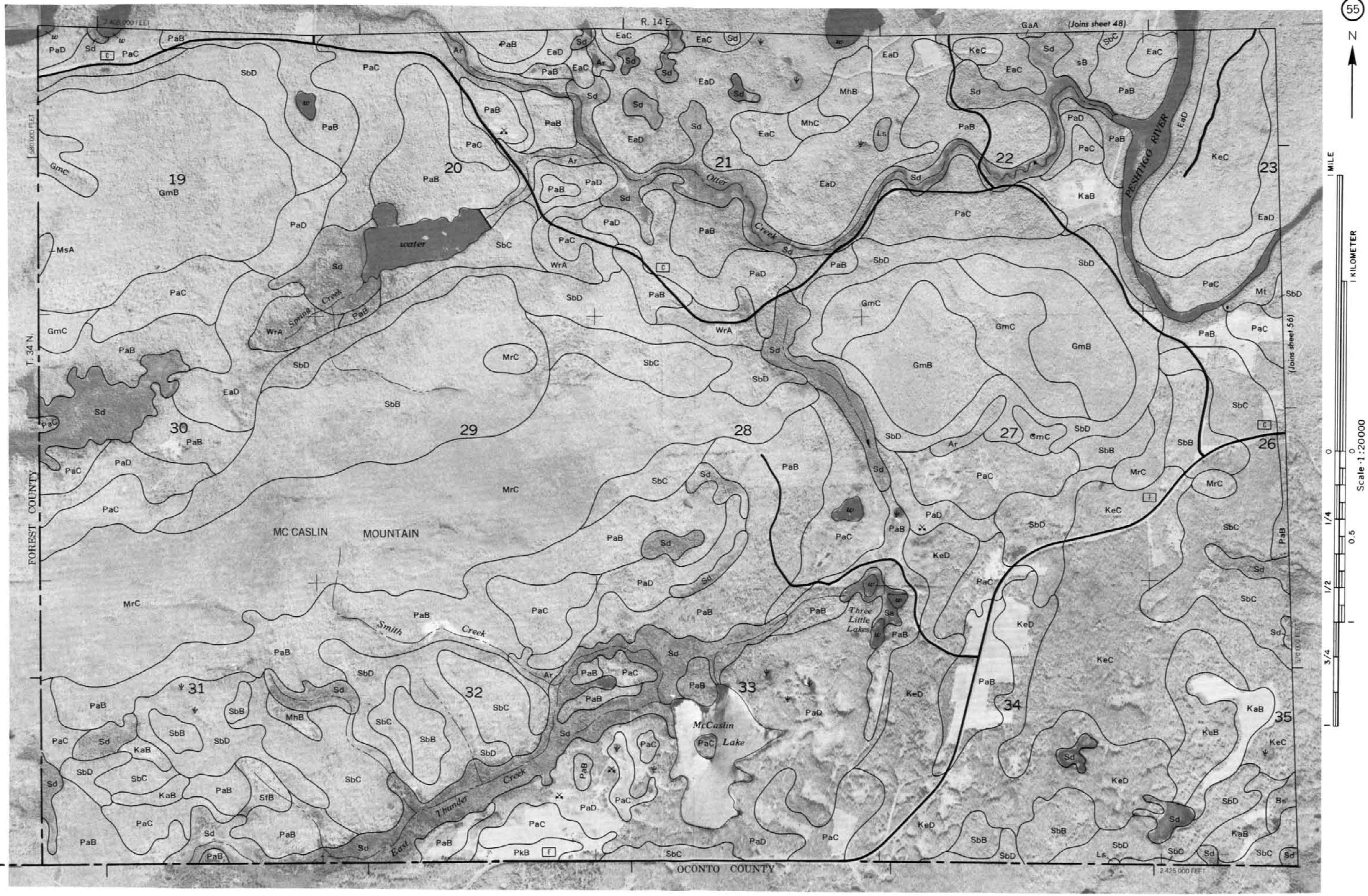
53



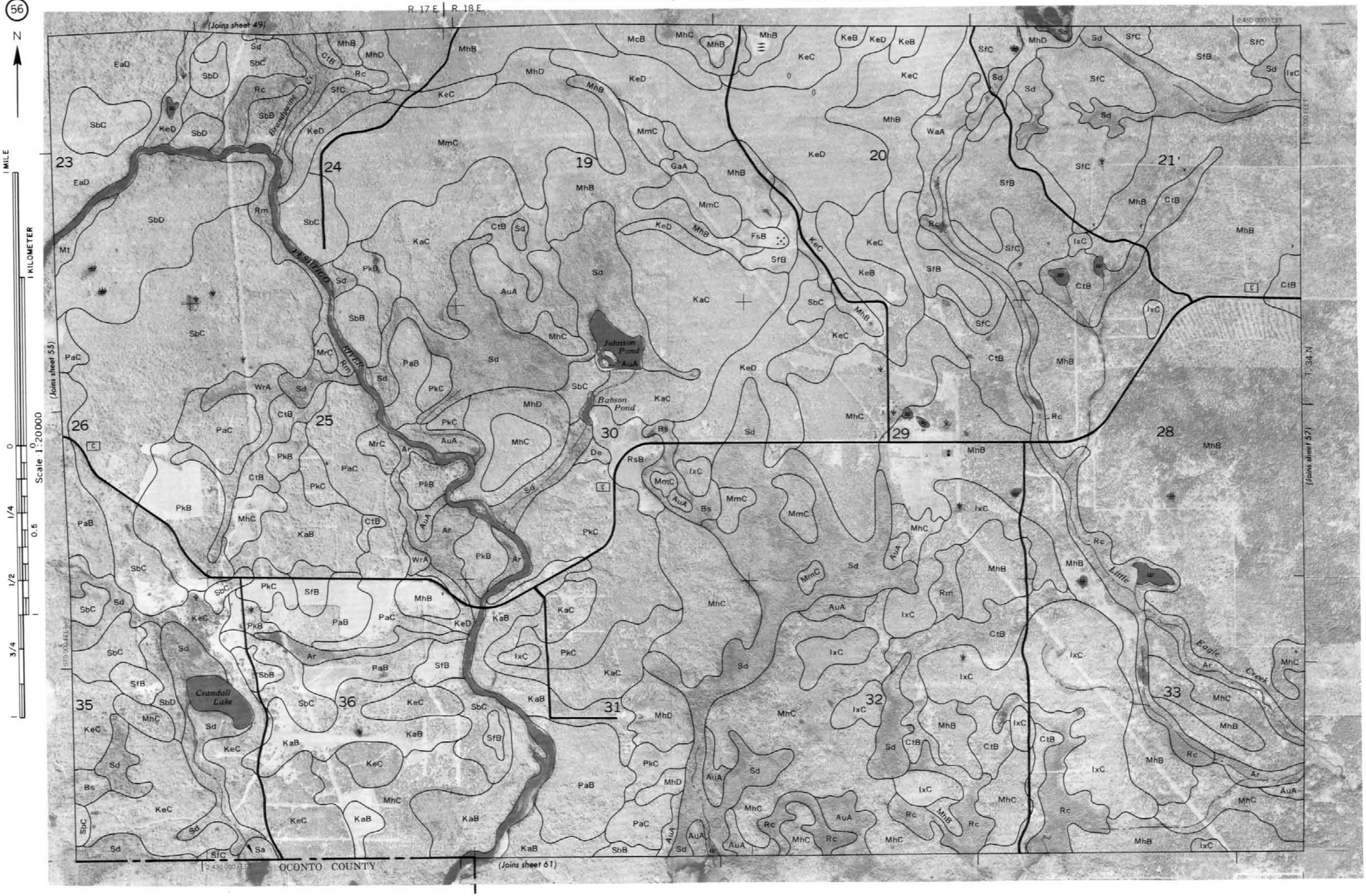
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 54

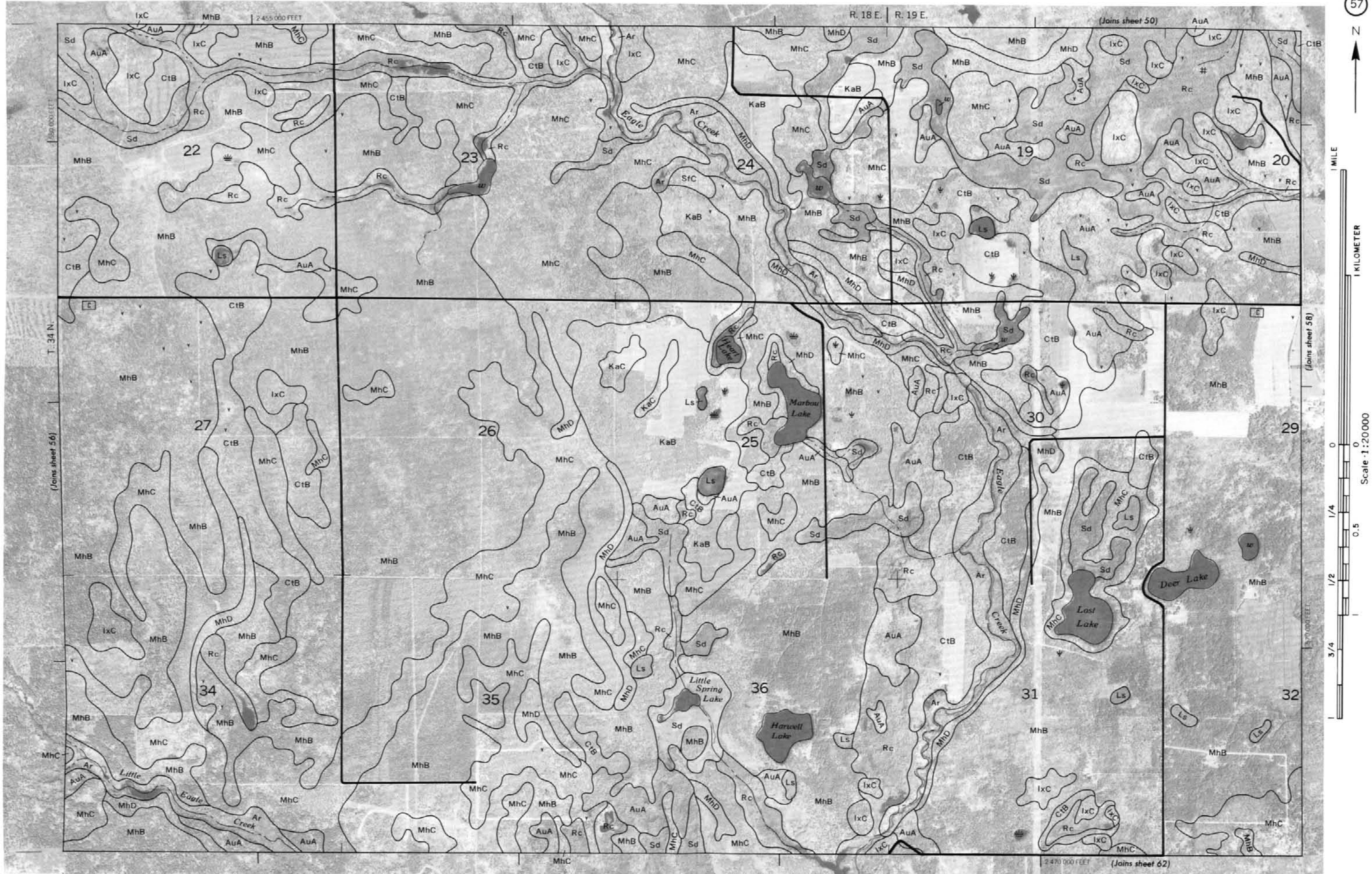


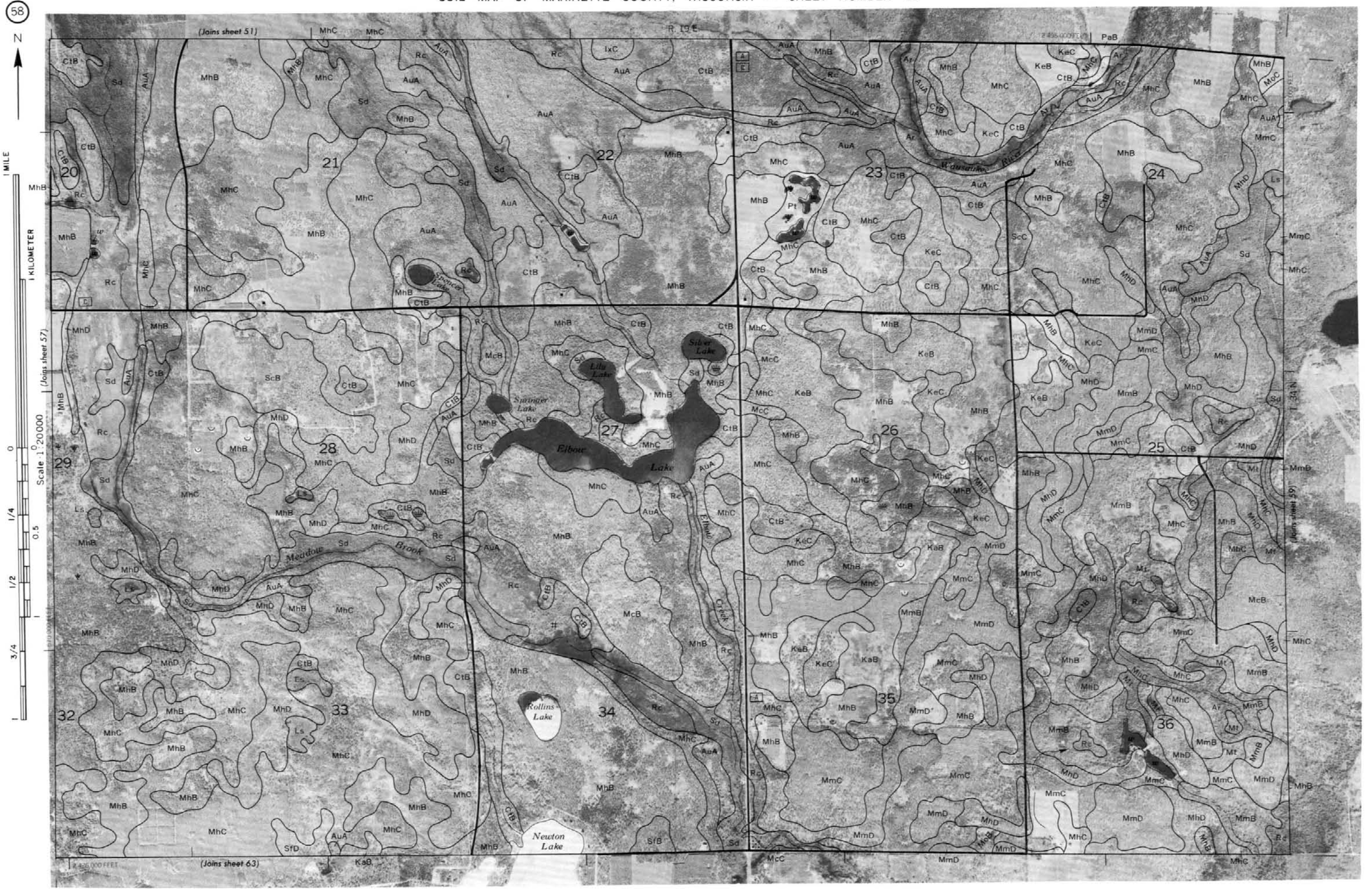
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 55



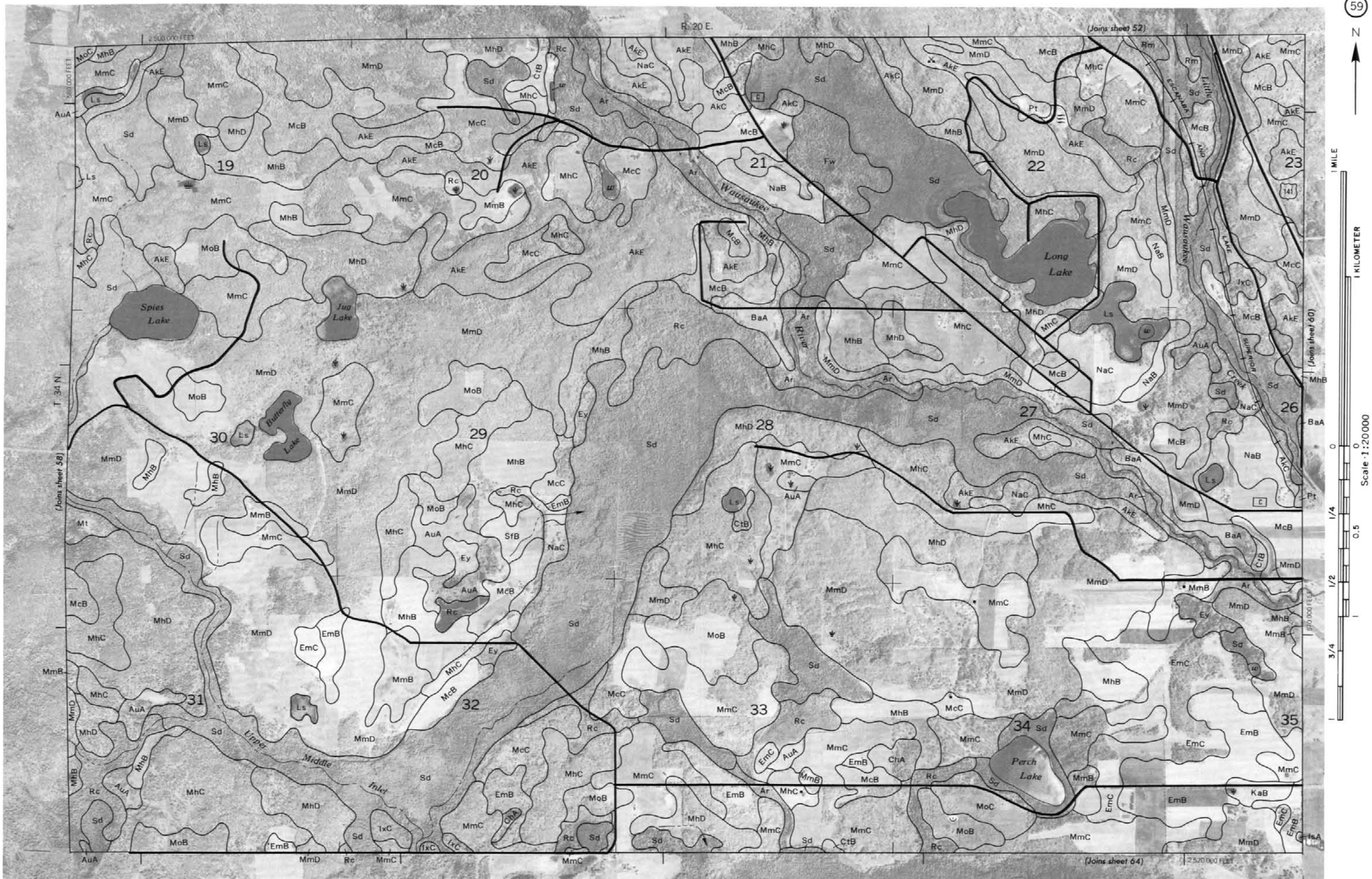
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 56



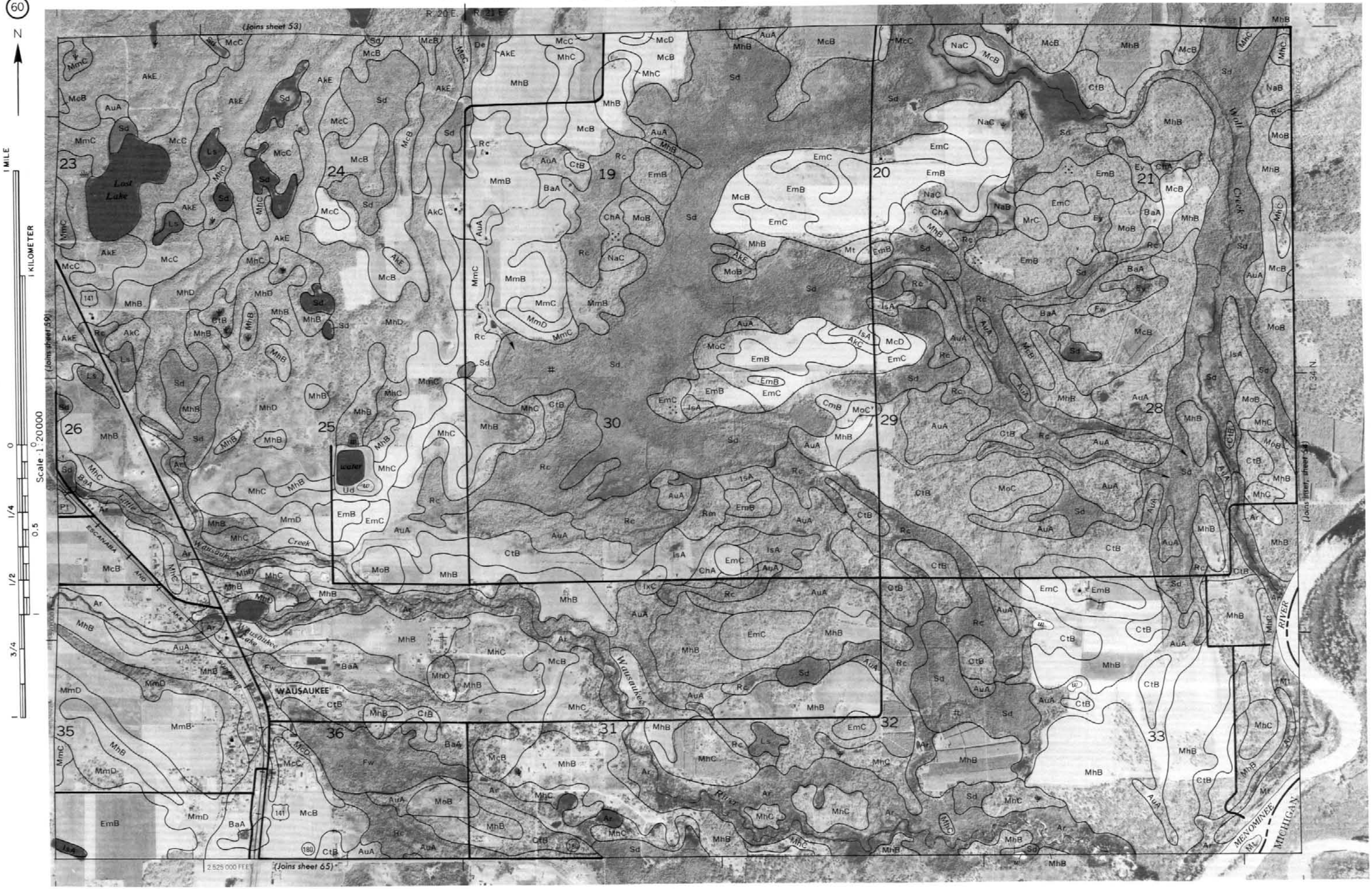

57
N
(Joins sheet 50)
(Joins sheet 56)
(Joins sheet 58)
(Joins sheet 62)
R. 18 E.
R. 19 E.
T. 34 N.
2 455 000 FEET
2 470 000 FEET
Eagle Creek
Little Eagle Creek
Heart Lake
Marbou Lake
Little Spring Lake
Harwell Lake
Lost Lake
Deer Lake
19
20
22
23
24
25
26
27
29
30
31
32
34
35
36
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

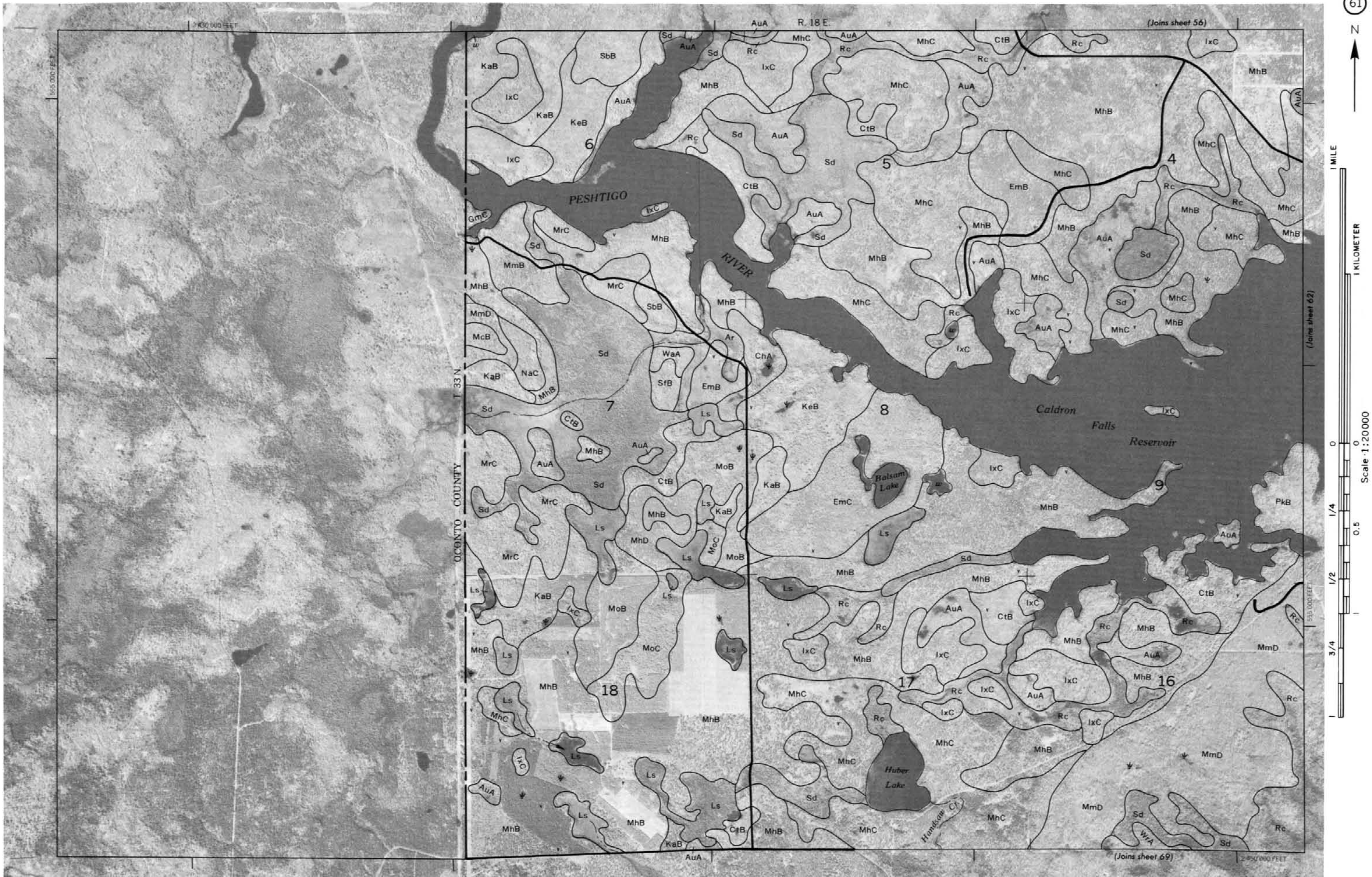

58
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 51)
(Joins sheet 57)
(Joins sheet 59)
(Joins sheet 63)
R. 19 E.
T. 34 N.
2 435 000 FEET
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
Spencer Lake
Lily Lake
Silver Lake
Springer Lake
Elbow Lake
Elbow Creek
Meadow Brook
Rollins Lake
Newton Lake
Wausaukee River

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 59



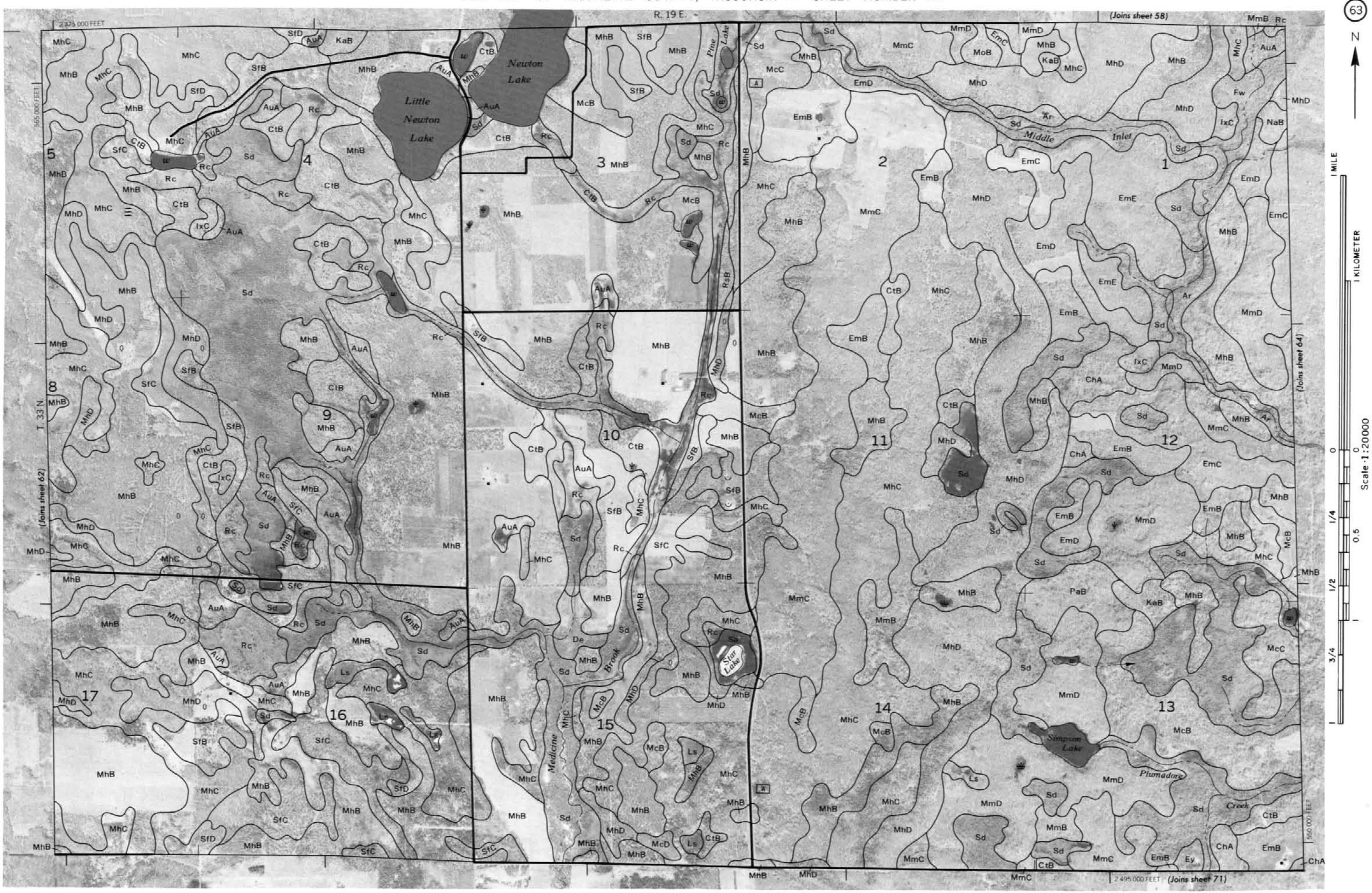
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 60

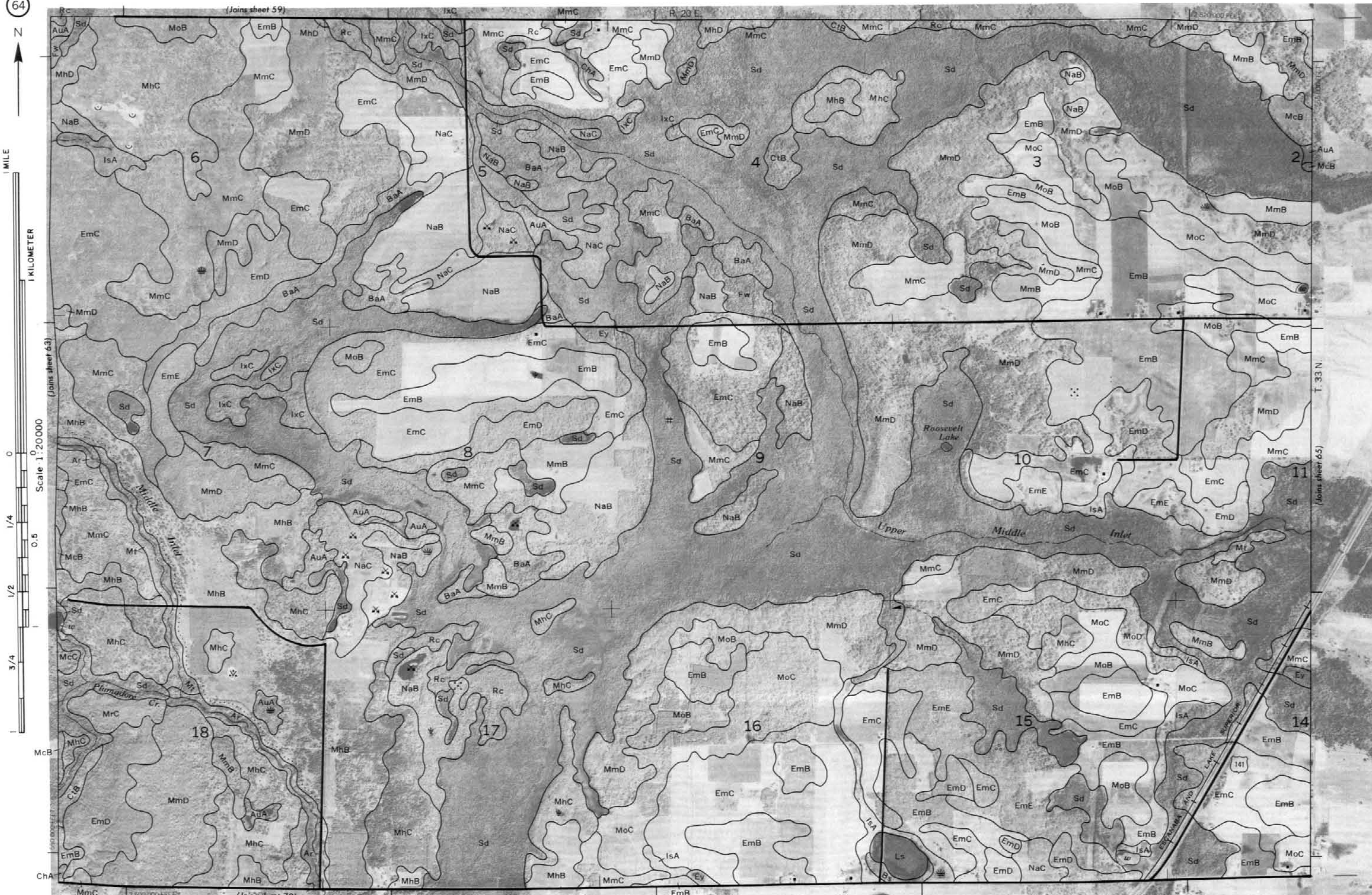



61
N
R. 18 E.
(Joins sheet 56)
(Joins sheet 62)
(Joins sheet 69)
T. 33 N.
OCONTO COUNTY
PESHTIGO
RIVER
Caldron
Falls
Reservoir
Balsam Lake
Huber Lake
Handsaw Cr.
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
4
5
6
7
8
9
16
17
18
AuA
Rc
MhC
CtB
IxC
MhB
Sd
SbB
KaB
KeB
EmB
EmC
GmC
MrC
MmB
MmD
McB
NaC
WaA
SfB
Ar
ChA
Ls
MoB
MoC
MhD
PkB
WfA

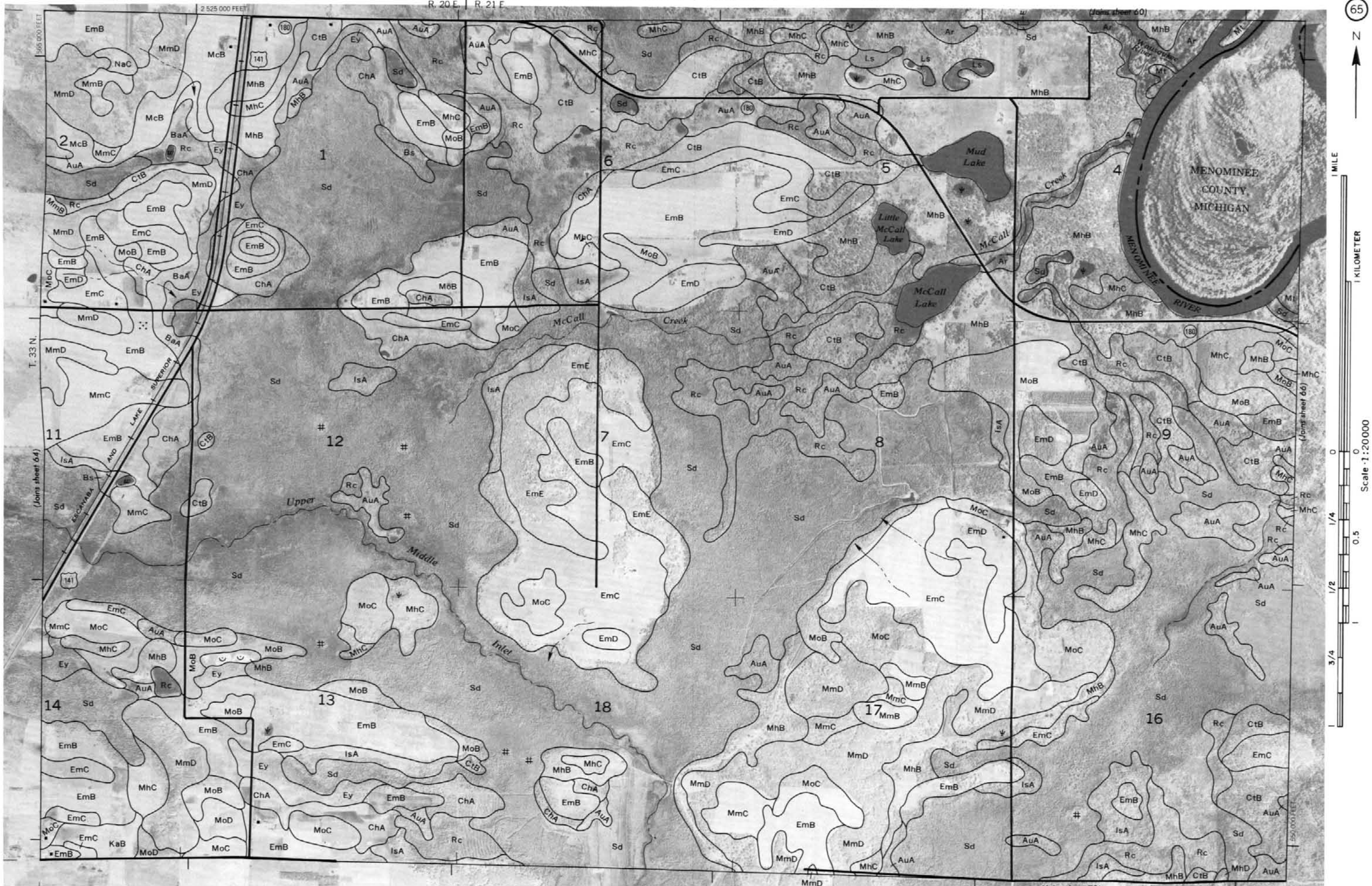

(Joins sheet 57)
(Joins sheet 61)
(Joins sheet 63)
(Joins sheet 70)
R. 18 E.
R. 19 E.
T. 33 N.
Caldron Falls Reservoir
High Falls Reservoir
PESHTIGO RIVER
Little Eagle Creek
Eagle Creek
Kahles Pond
Old Veteran Lake
Angle Lake
Old Veteran Lake Park
Outlet
Woods Lake
N
1 MILE
1 KILOMETER
Scale 1:20000

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 63

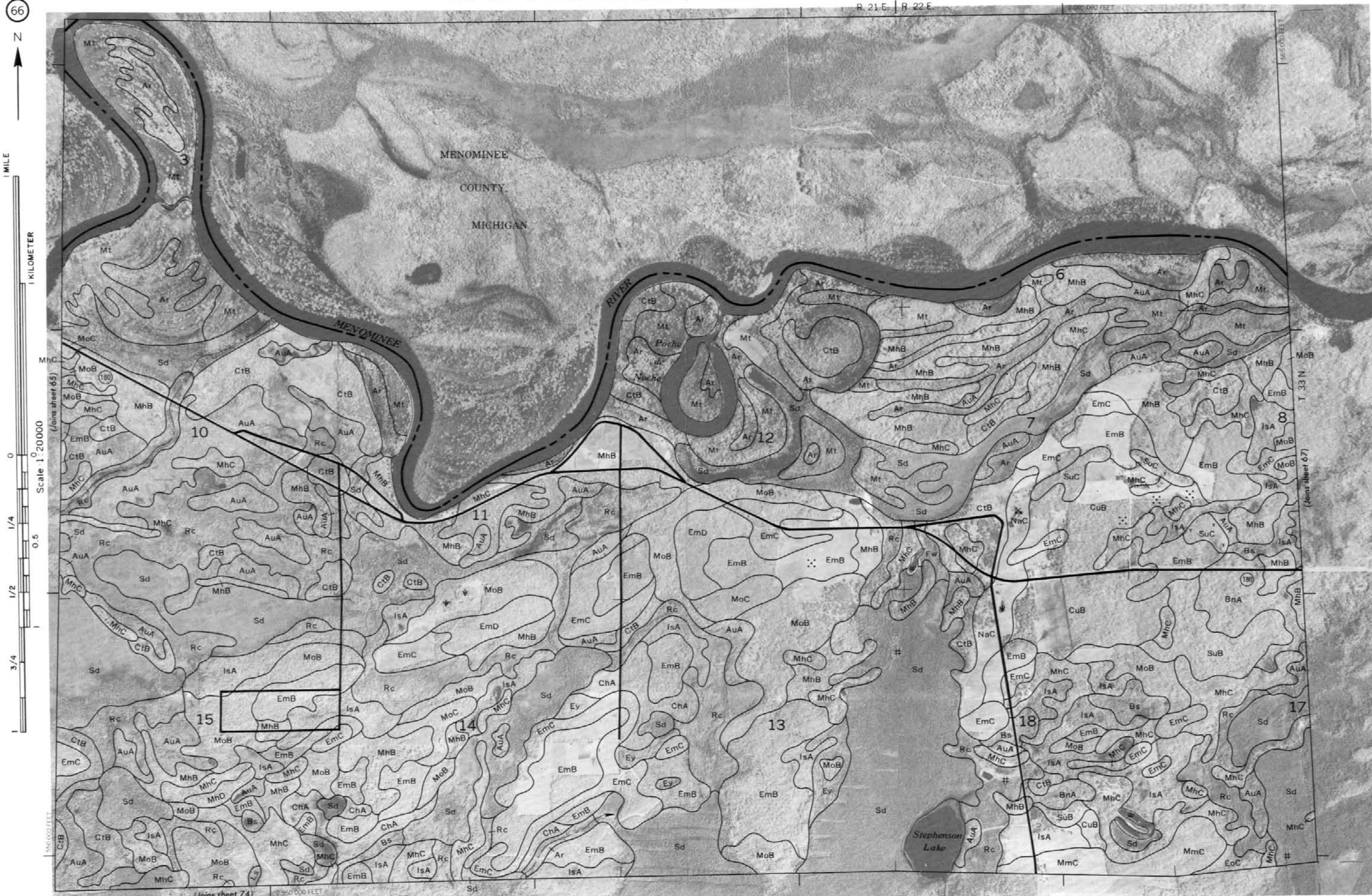



64
N
(Joins sheet 59)
(Joins sheet 63)
(Joins sheet 65)
(Joins sheet 72)
R. 20 E.
T. 33 N.
1 MILE
1 KILOMETER
Scale 1:20000
Roosevelt Lake
Upper Middle Inlet
Middle Inlet
Plumadore Cr.
Escanaba and Lake Superior
141

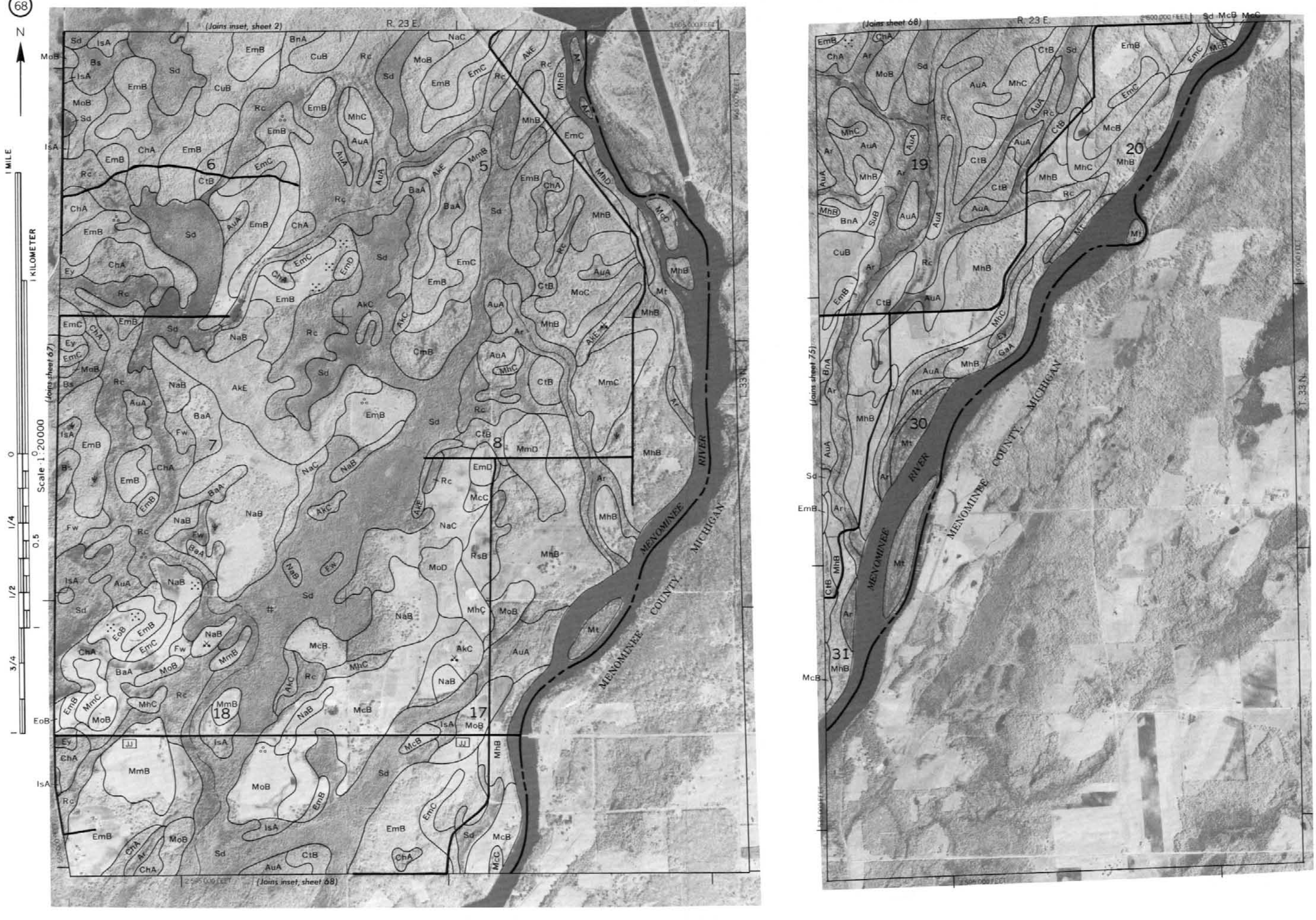
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 65

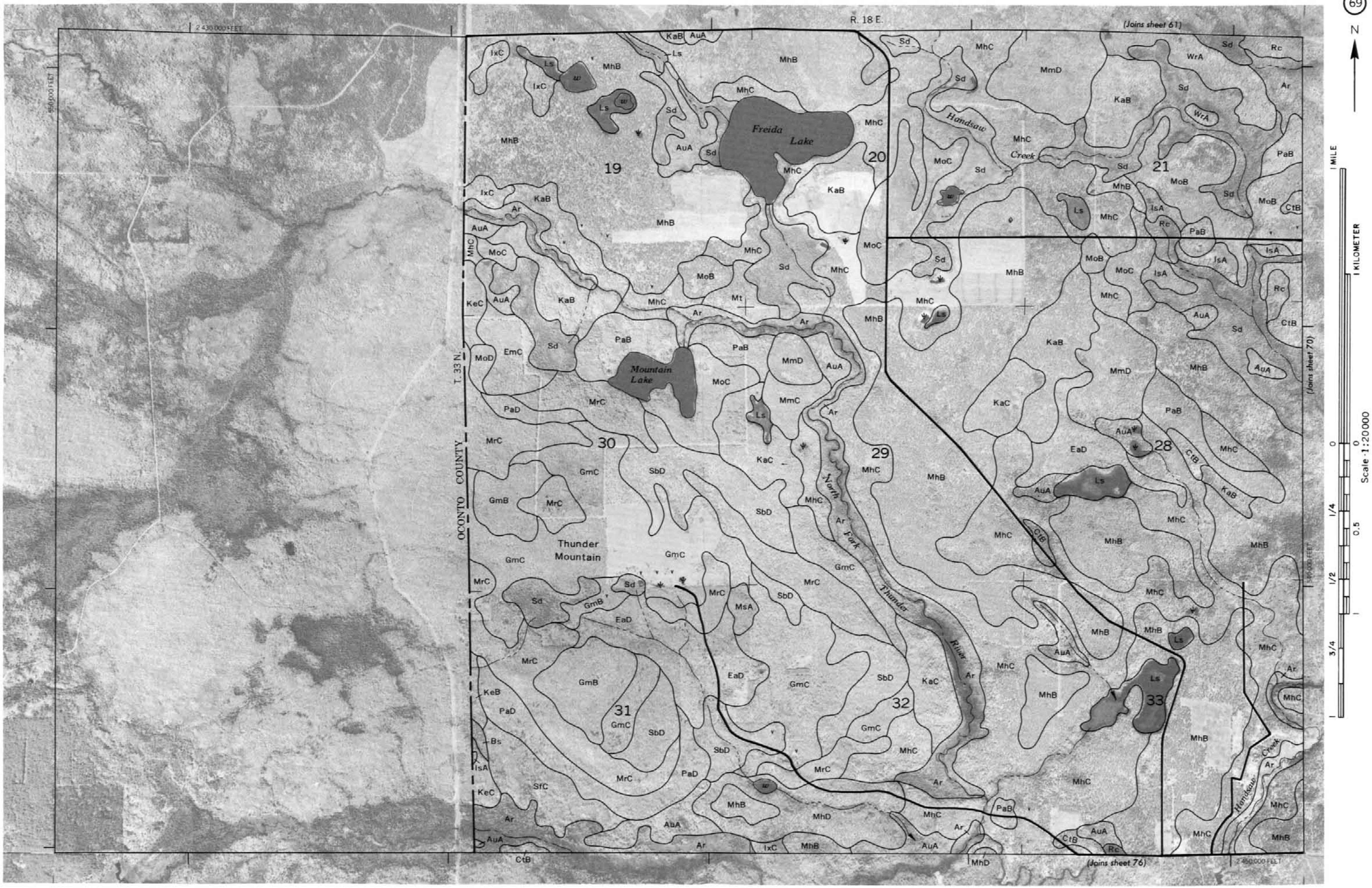


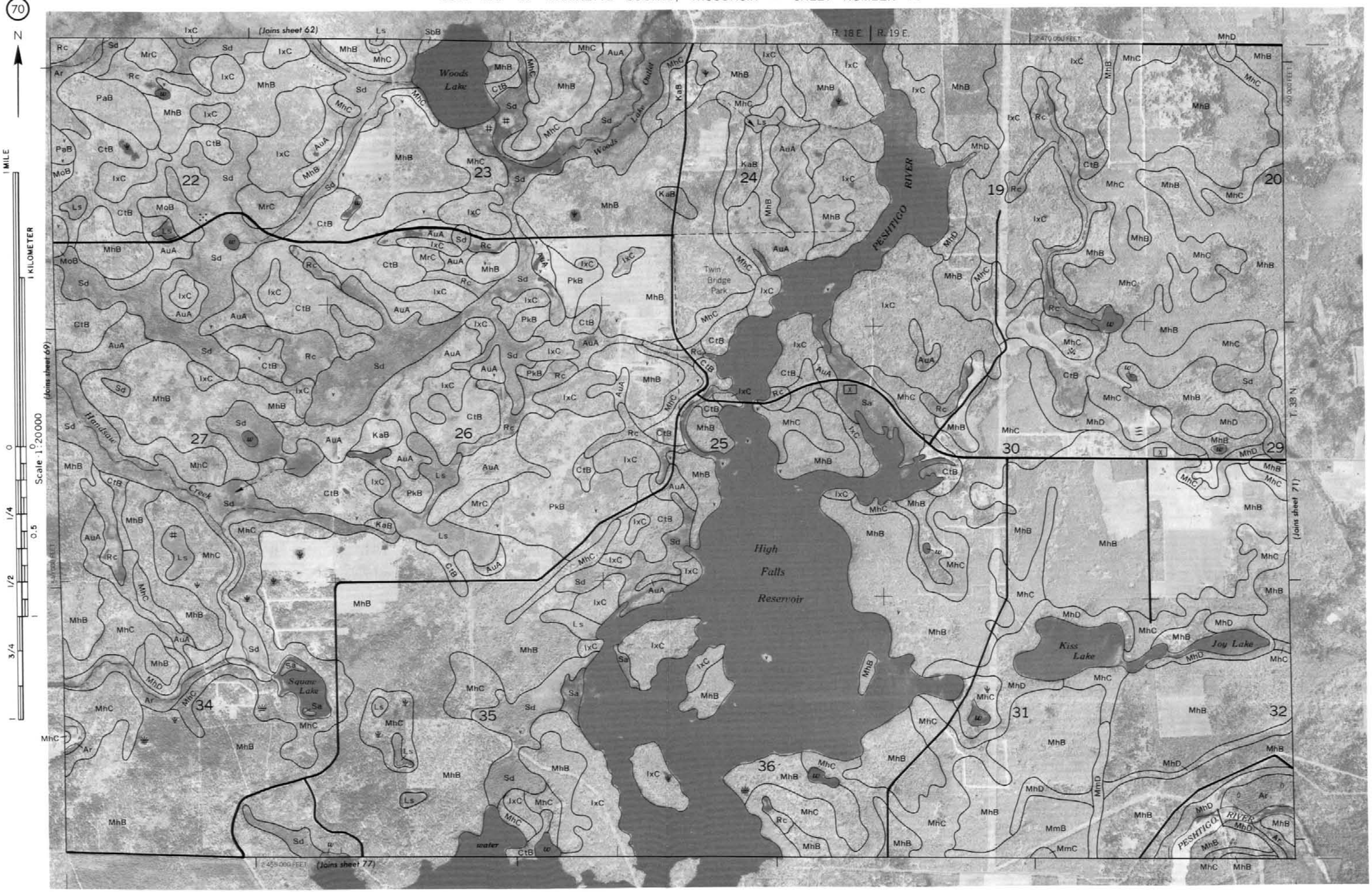
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 66



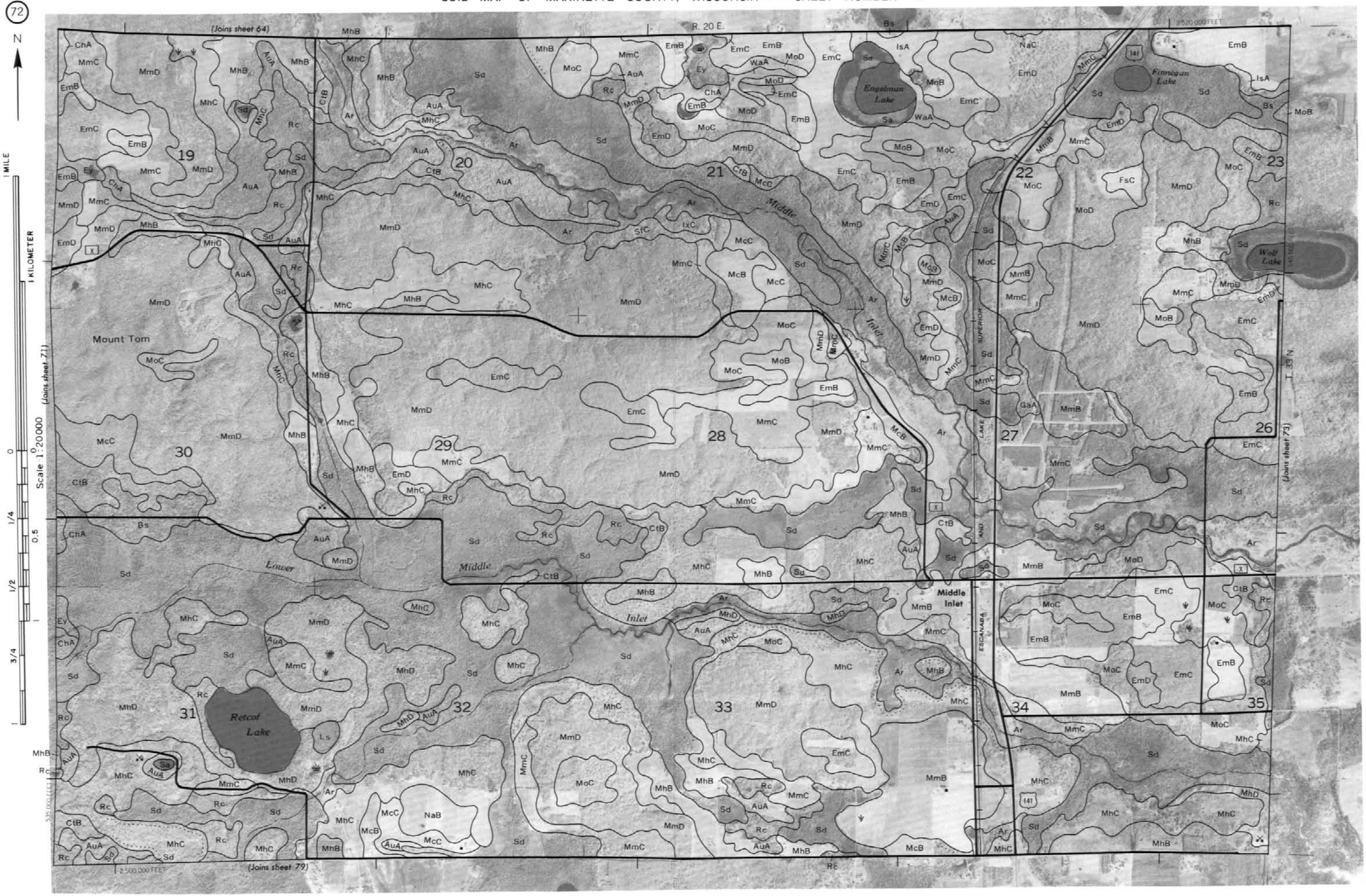
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 67


68
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
1
(Joins inset, sheet 2)
R. 23 E.
(Joins sheet 67)
(Joins inset, sheet 68)
(Joins sheet 68)
(Joins sheet 75)
T. 33 N.
MENOMINEE RIVER
MENOMINEE COUNTY, MICHIGAN
6
5
7
8
17
18
19
20
30
31

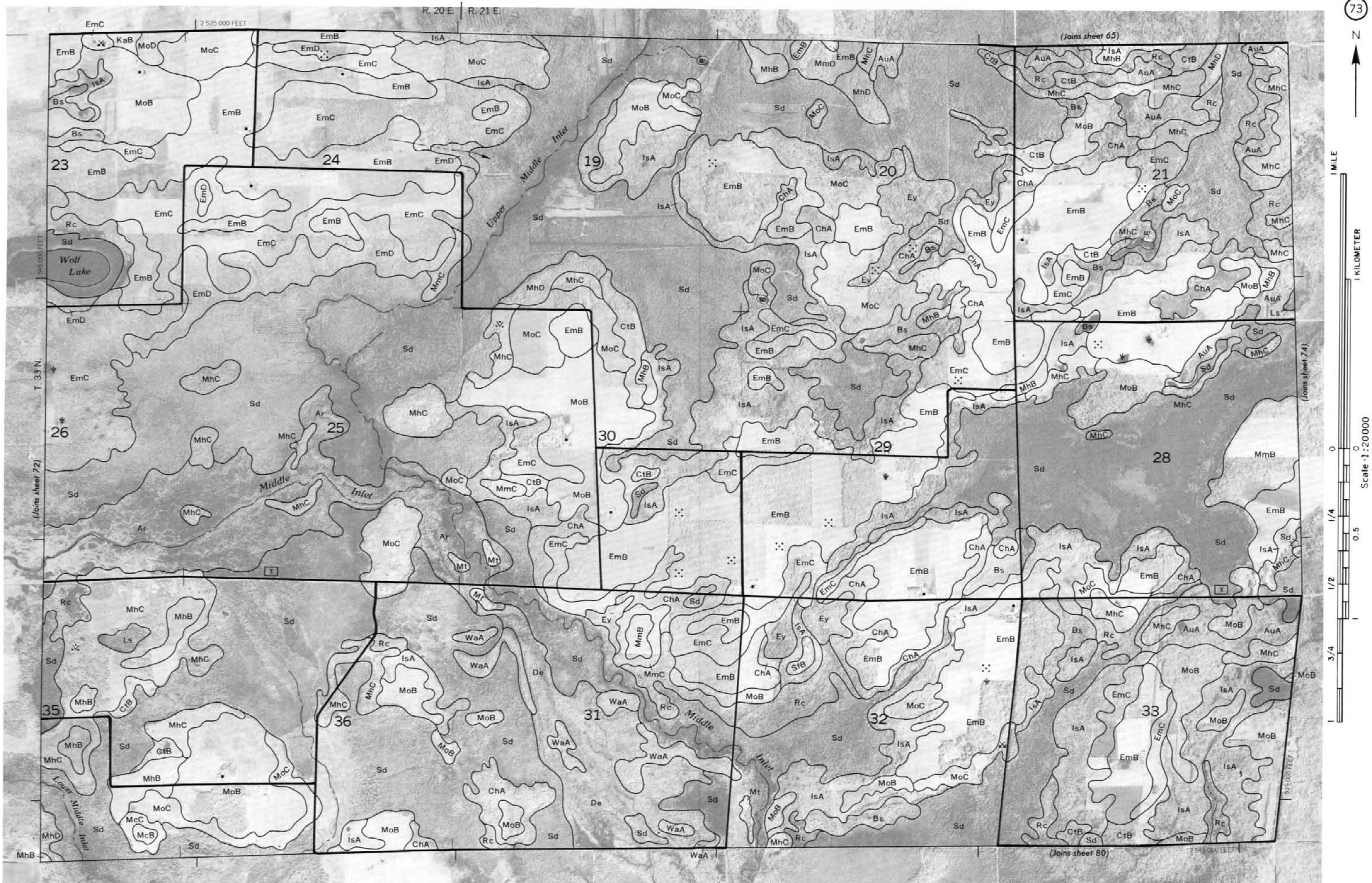

69
N
R. 18 E.
(Joins sheet 61)
(Joins sheet 70)
(Joins sheet 76)
2 430 000 FEET
2 450 000 FEET
T. 33 N.
OCONTO COUNTY
Freida Lake
Mountain Lake
Thunder Mountain
Handsaw Creek
North Fork Thunder River
19
20
21
28
29
30
31
32
33
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5


70
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
(Joins sheet 62)
(Joins sheet 69)
(Joins sheet 71)
(Joins sheet 77)
R. 18 E.
R. 19 E.
T. 33 N.
2 470 000 FEET
2 455 000 FEET
Woods Lake
Woods Lake Outlet
PESHTIGO RIVER
Twin Bridge Park
High Falls Reservoir
Handsaw Creek
Squaw Lake
Kiss Lake
Joy Lake
water
19
20
22
23
24
25
26
27
29
30
31
32
34
35
36

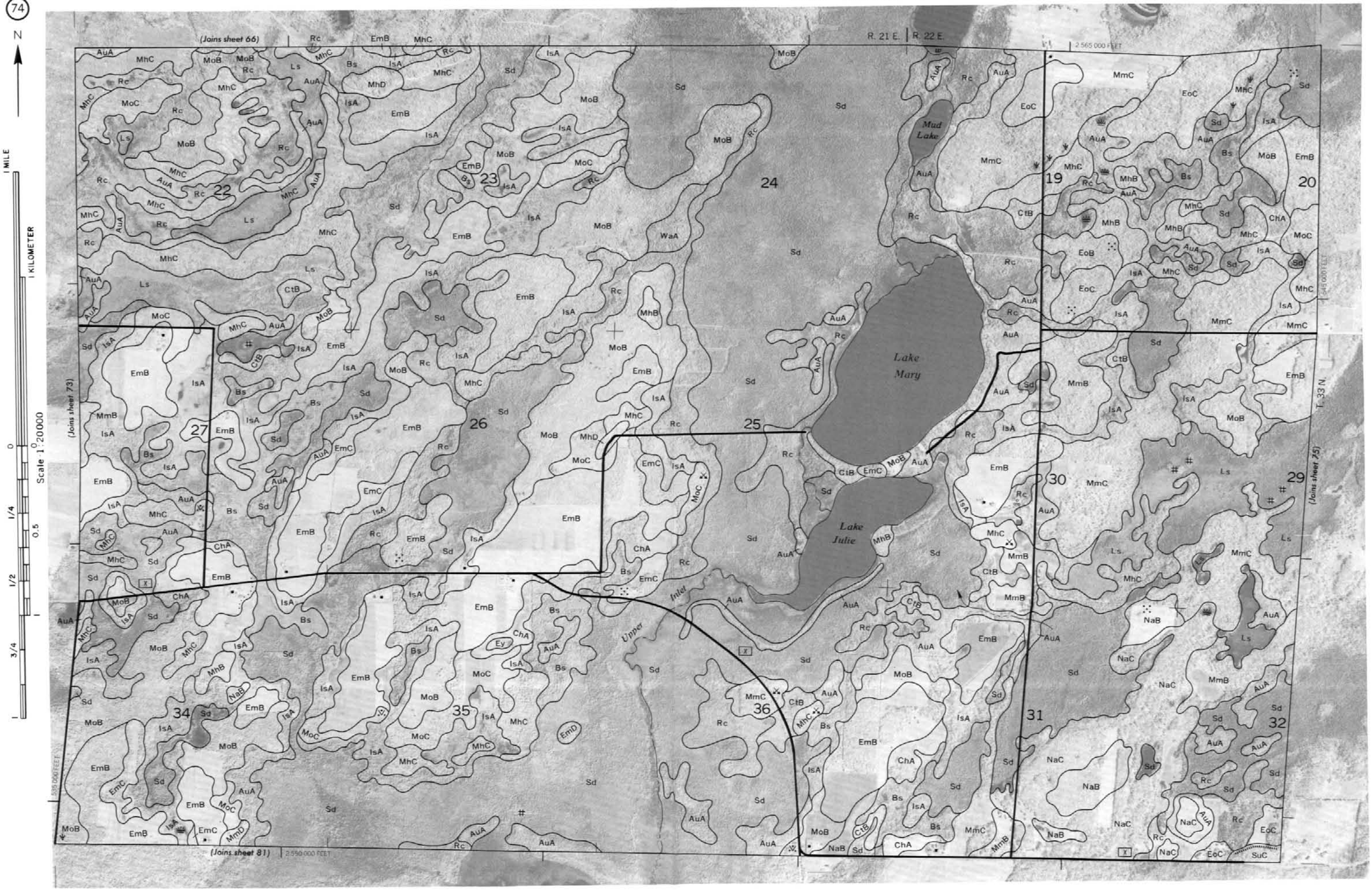

71
N
R. 19 E.
T. 33 N.
(Joins sheet 63)
(Joins sheet 72)
(Joins sheet 78)
(Joins sheet 70)
2 475 000 FEET
2 495 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
Medicine Brook
Chrizel Lake
Lower Middle Inlet
Pestigo R.
water


72
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
1
(Joins sheet 64)
R. 20 E.
(Joins sheet 71)
(Joins sheet 73)
(Joins sheet 79)
T. 33 N.
2 500 000 FEET
535 000 FEET
Mount Tom
Engelman Lake
Finnegan Lake
Wolf Lake
Retcof Lake
Middle Inlet
Lower
Middle
Inlet
SUPERIOR
LAKE
AND
ESCANABA
141
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35

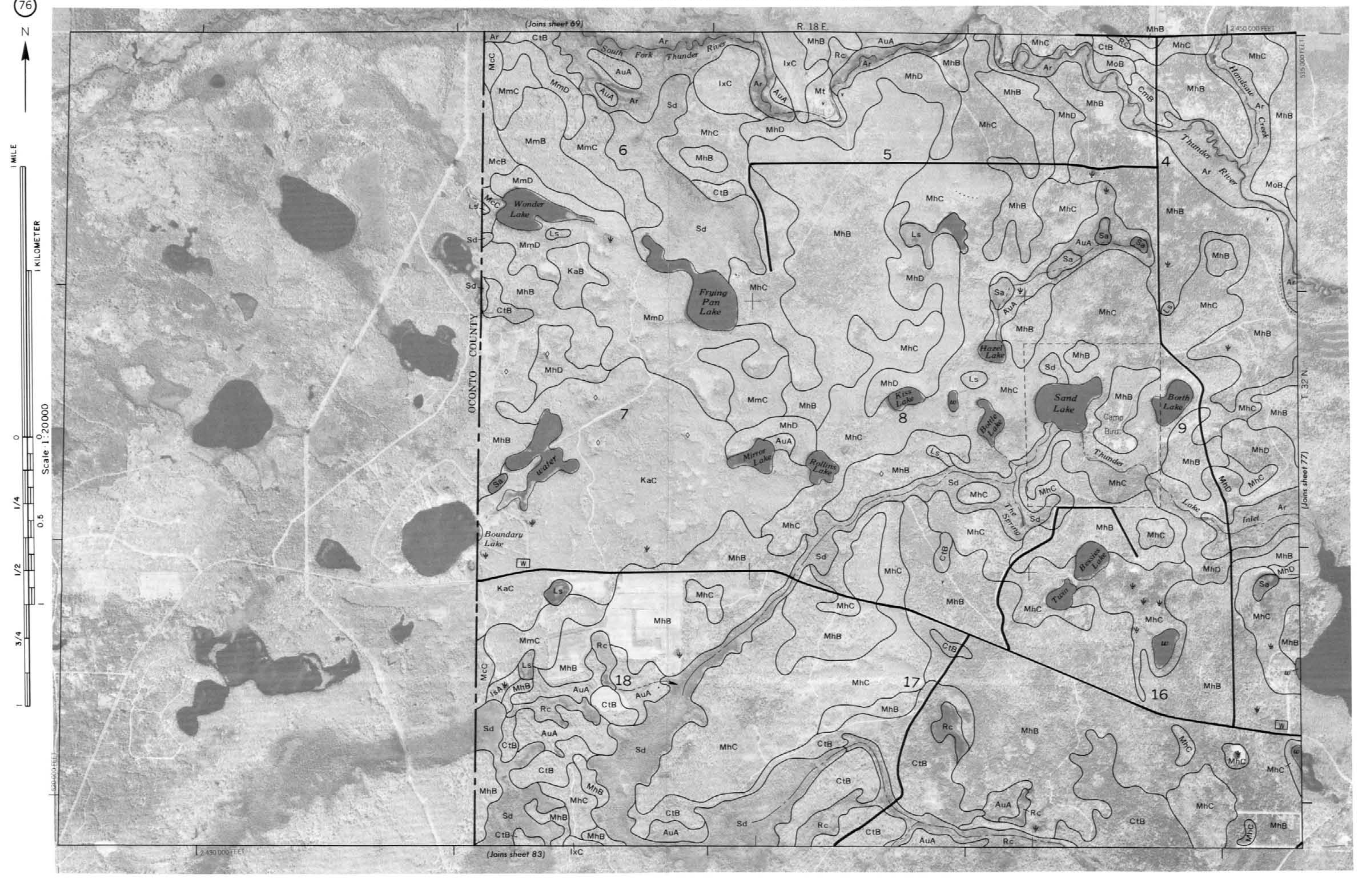
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 73

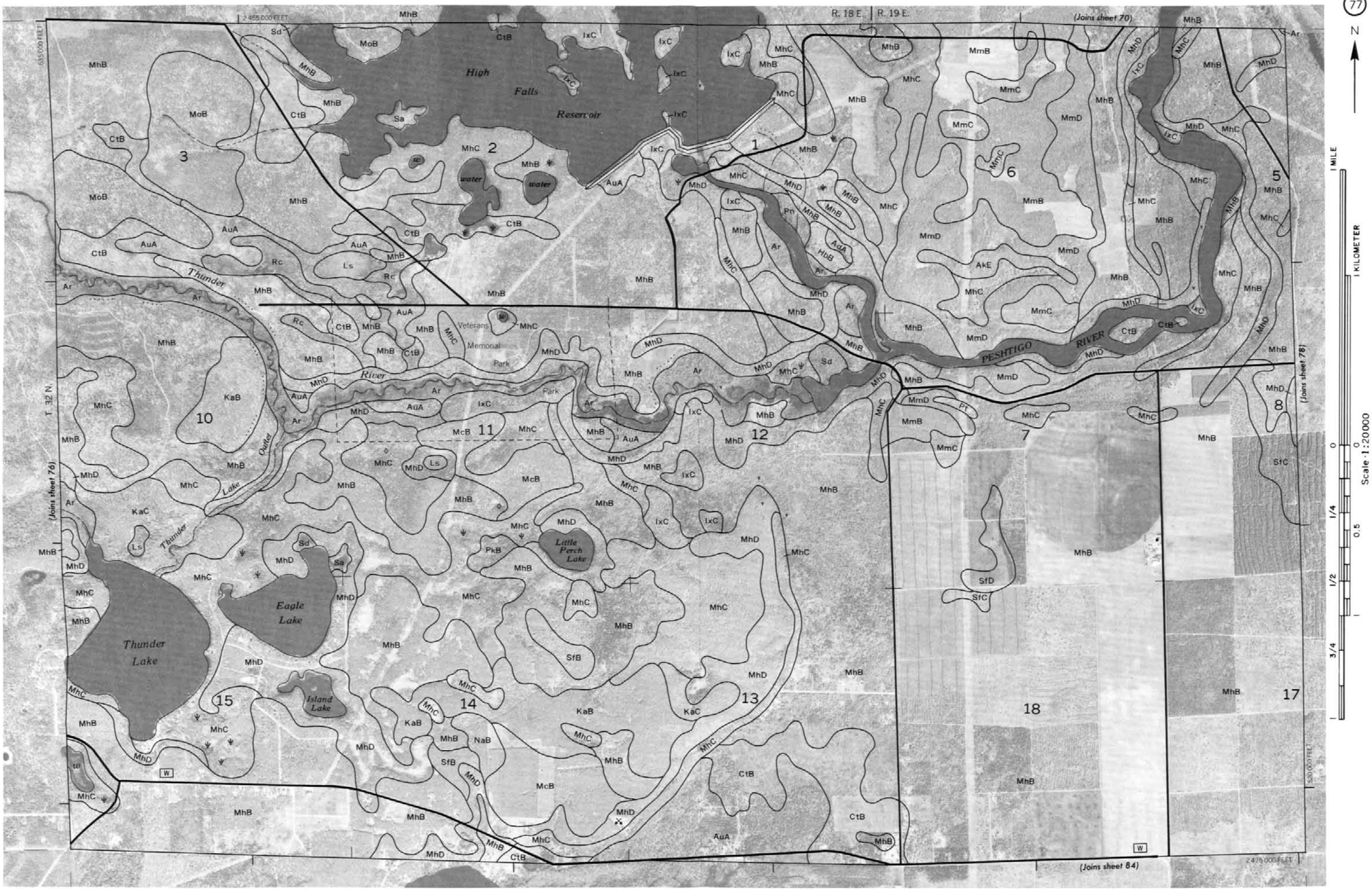


74


N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 66)
(Joins sheet 73)
(Joins sheet 75)
(Joins sheet 81)
R. 21 E.
R. 22 E.
T. 33 N.
Mud Lake
Lake Mary
Lake Julie
Upper Inlet
19
20
22
23
24
25
26
27
29
30
31
32
34
35
36

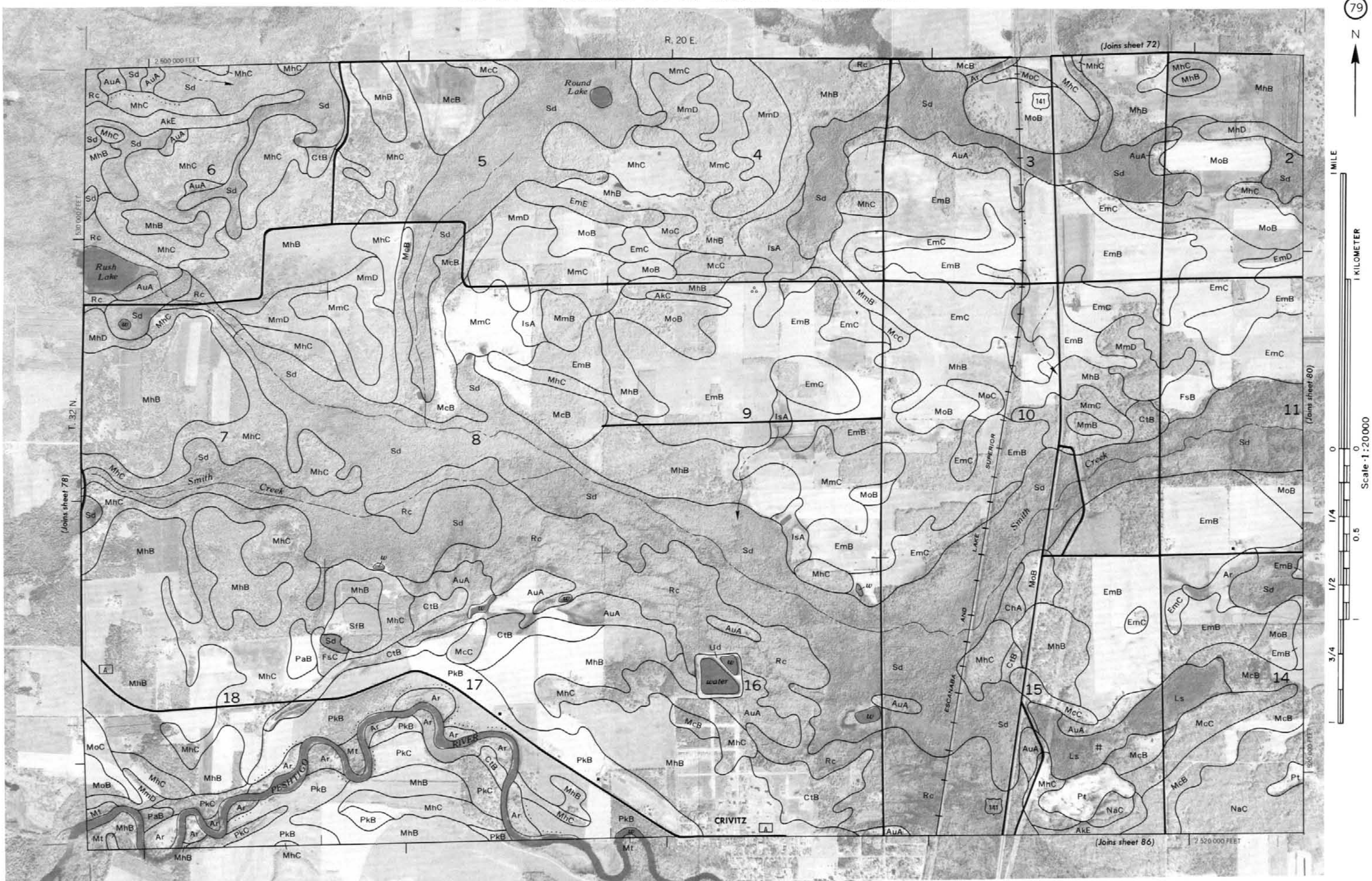

75
N
R. 22 E.
T. 33 N.
(Joins sheet 67)
(Joins sheet 68)
(Joins sheet 74)
(Joins sheet 82)
2 570 000 FEET
2 590 000 FEET
Wagner
Menominee River County Park
MENOMINEE RIVER
MENOMINEE CO., MI.
1 MILE
1 KILOMETER
Scale 1:20000
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36


76
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
(Joins sheet 69)
R. 18 E.
(Joins sheet 77)
(Joins sheet 83)
T. 32 N.
OCONTO COUNTY
South Fork Thunder River
Thunder River
Hamilton Creek
Wonder Lake
Frying Pan Lake
Hazel Lake
Kiss Lake
Mirror Lake
Rollins Lake
Bottle Lake
Sand Lake
Borth Lake
Camp Bird
Boundary Lake
Bessies Lake
Twin
The Spring
Lake Inlet
water
5
6
7
8
9
4
16
17
18

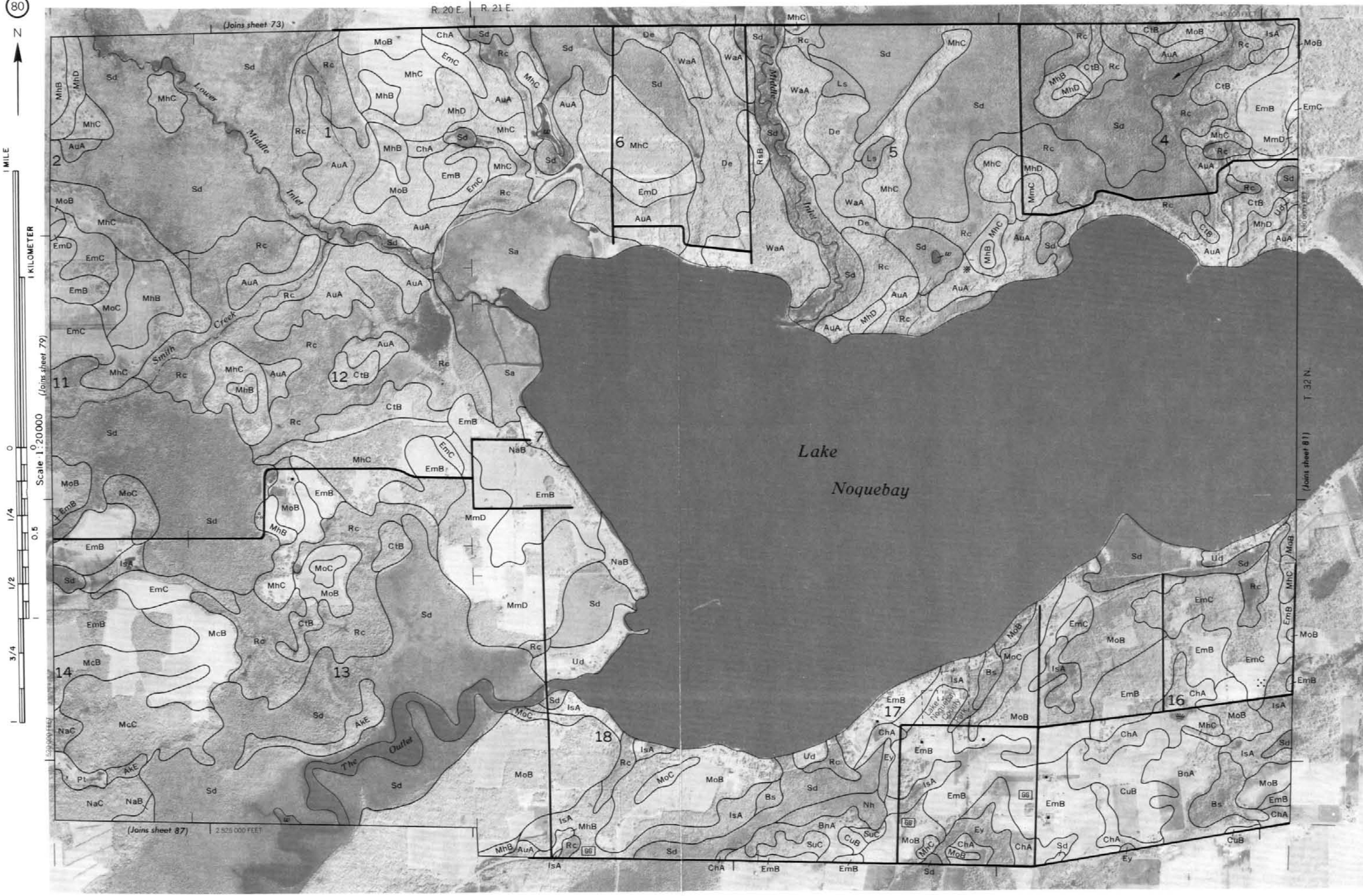

77
N
R. 18 E.
R. 19 E.
(Joins sheet 70)
(Joins sheet 78)
(Joins sheet 84)
(Joins sheet 76)
T. 32 N.
2 455 000 FEET
2 475 000 FEET
High Falls Reservoir
Thunder River
Thunder Lake Outlet
Peshtigo River
Veterans Memorial Park
Park
Little Perch Lake
Eagle Lake
Thunder Lake
Island Lake
water
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
1

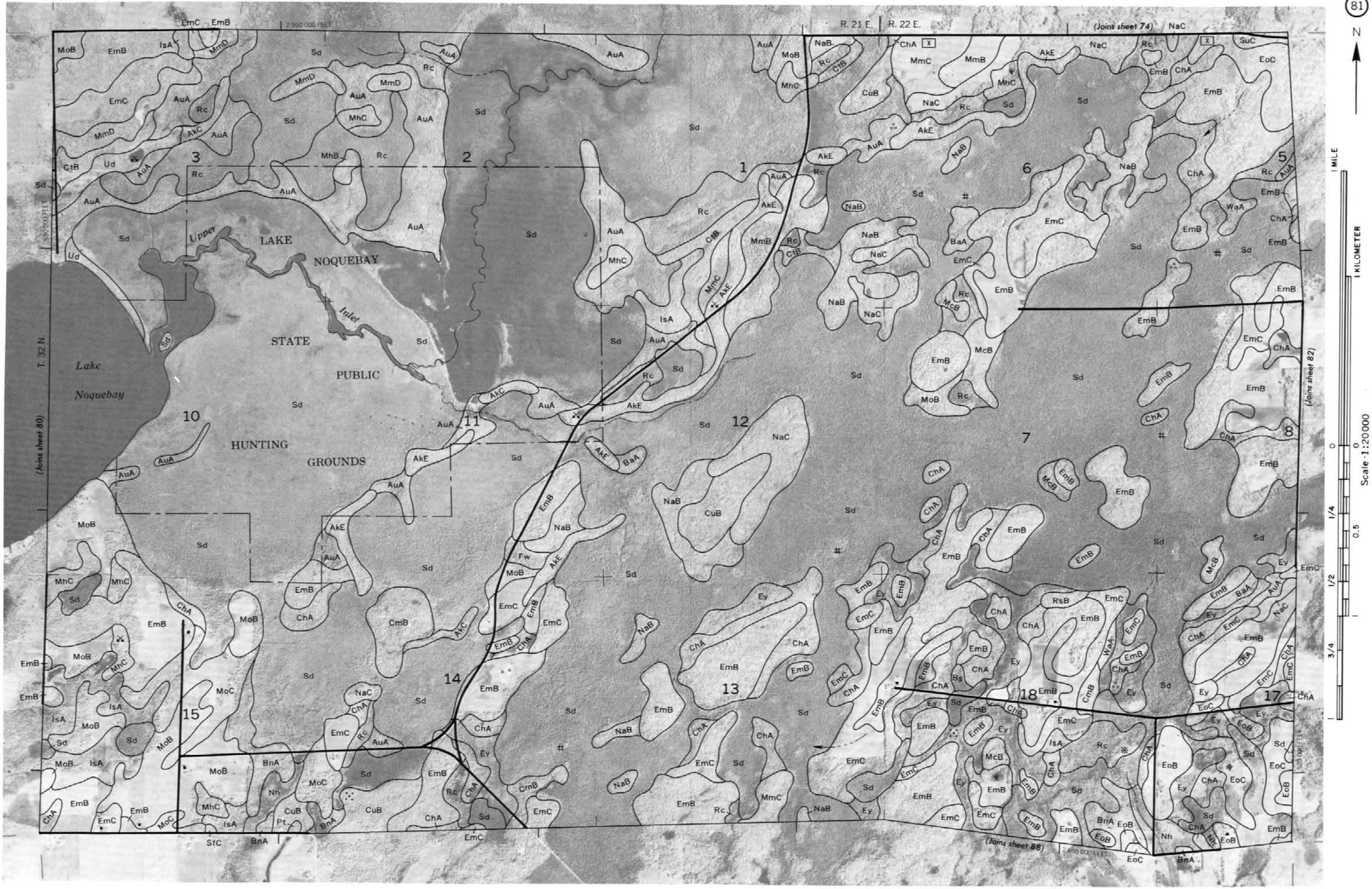

78
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 71)
(Joins sheet 77)
(Joins sheet 79)
(Joins sheet 85)
R. 19 E.
T. 32 N.
2 496 000 FEET
2 490 000 FEET
PESHTIGO RIVER
Campbell Lake
Charles Lake
Rush Lake

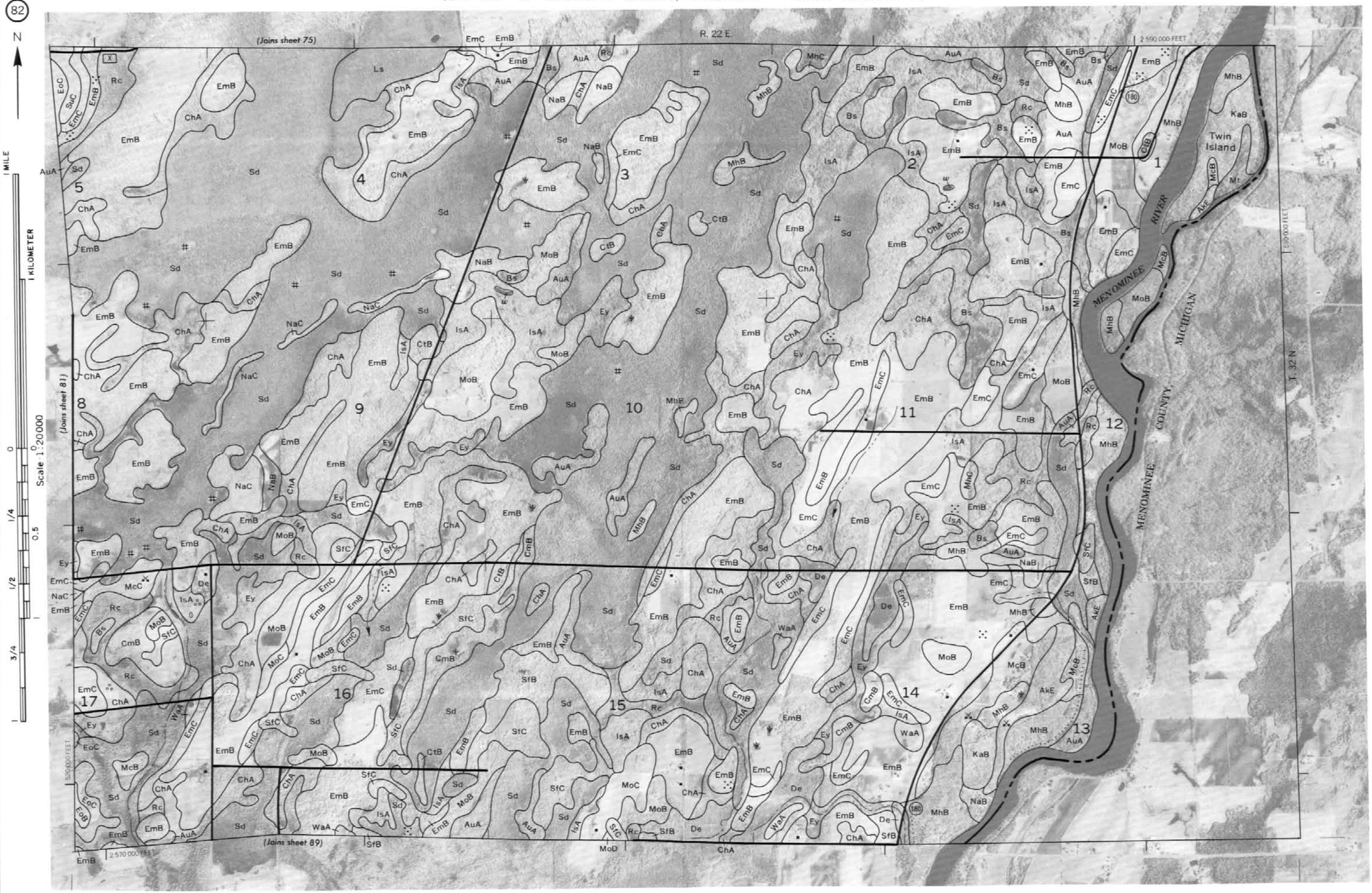
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 79



SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 80

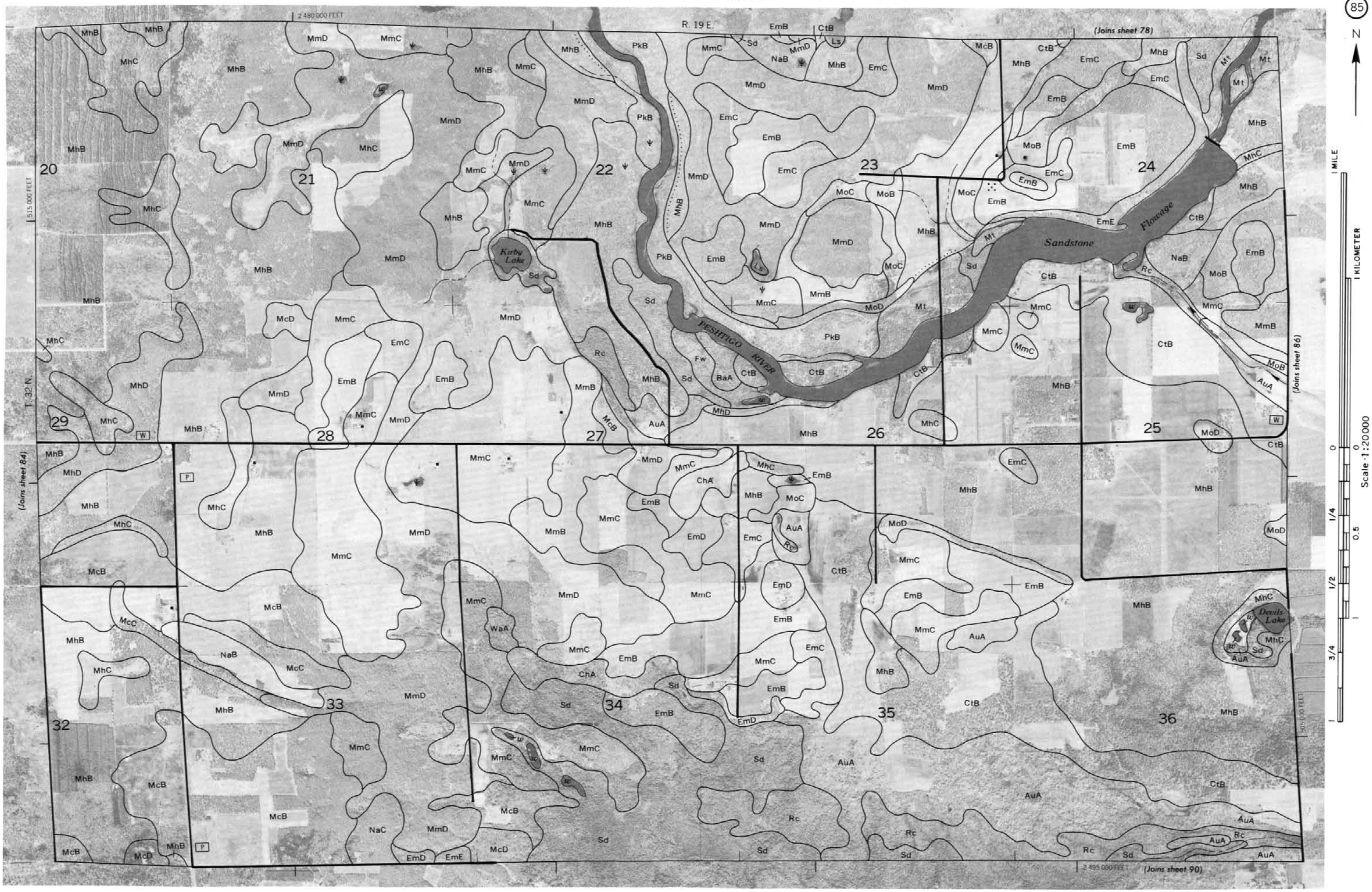


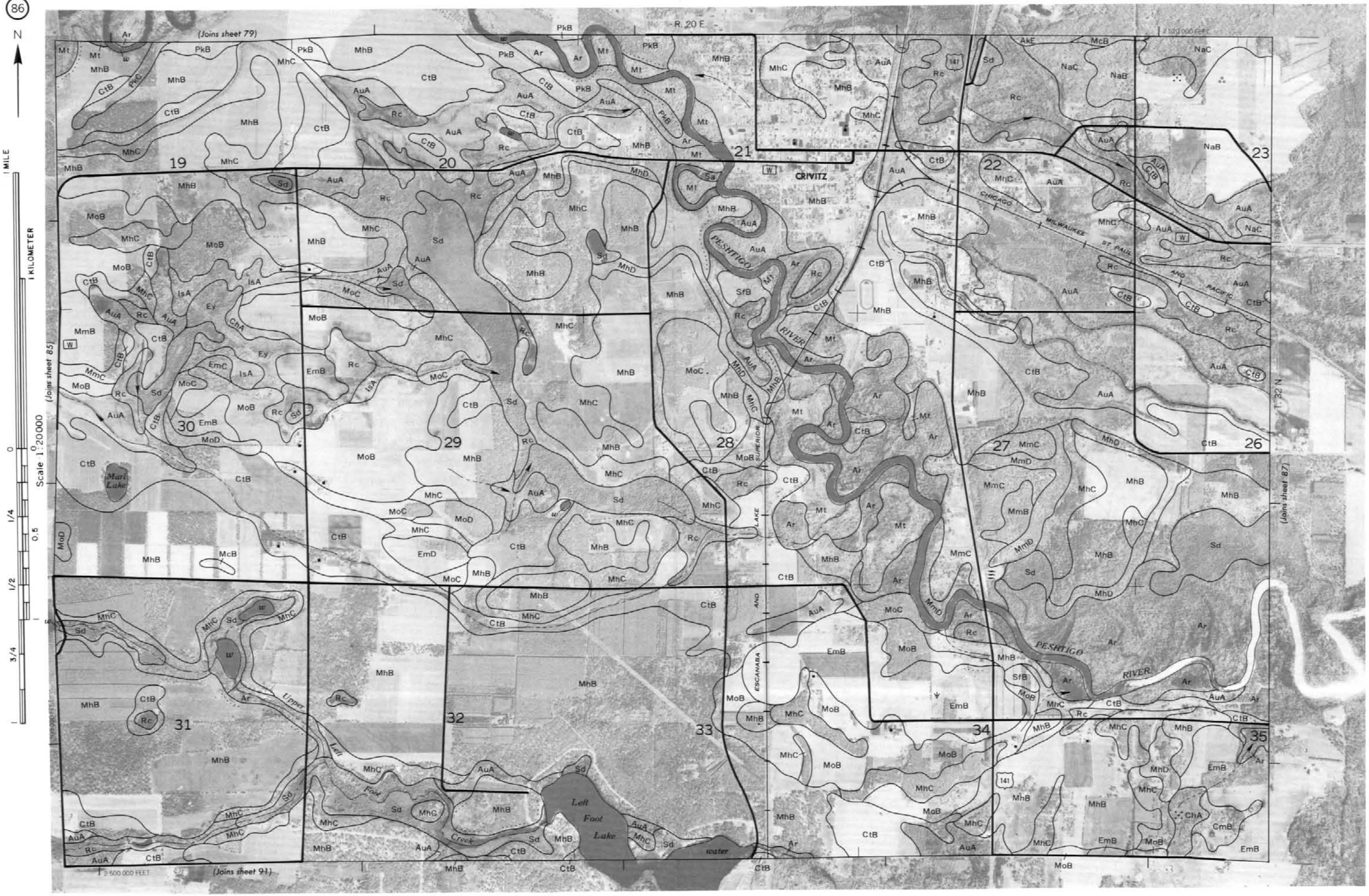

N
R. 21 E.
R. 22 E.
T. 32 N.
(Joins sheet 74)
(Joins sheet 80)
(Joins sheet 82)
(Joins sheet 88)
Lake Noquebay
Upper
LAKE
NOQUEBAY
Inlet
STATE
PUBLIC
HUNTING
GROUNDS
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18
2 550 000 FEET
2 565 000 FEET
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000

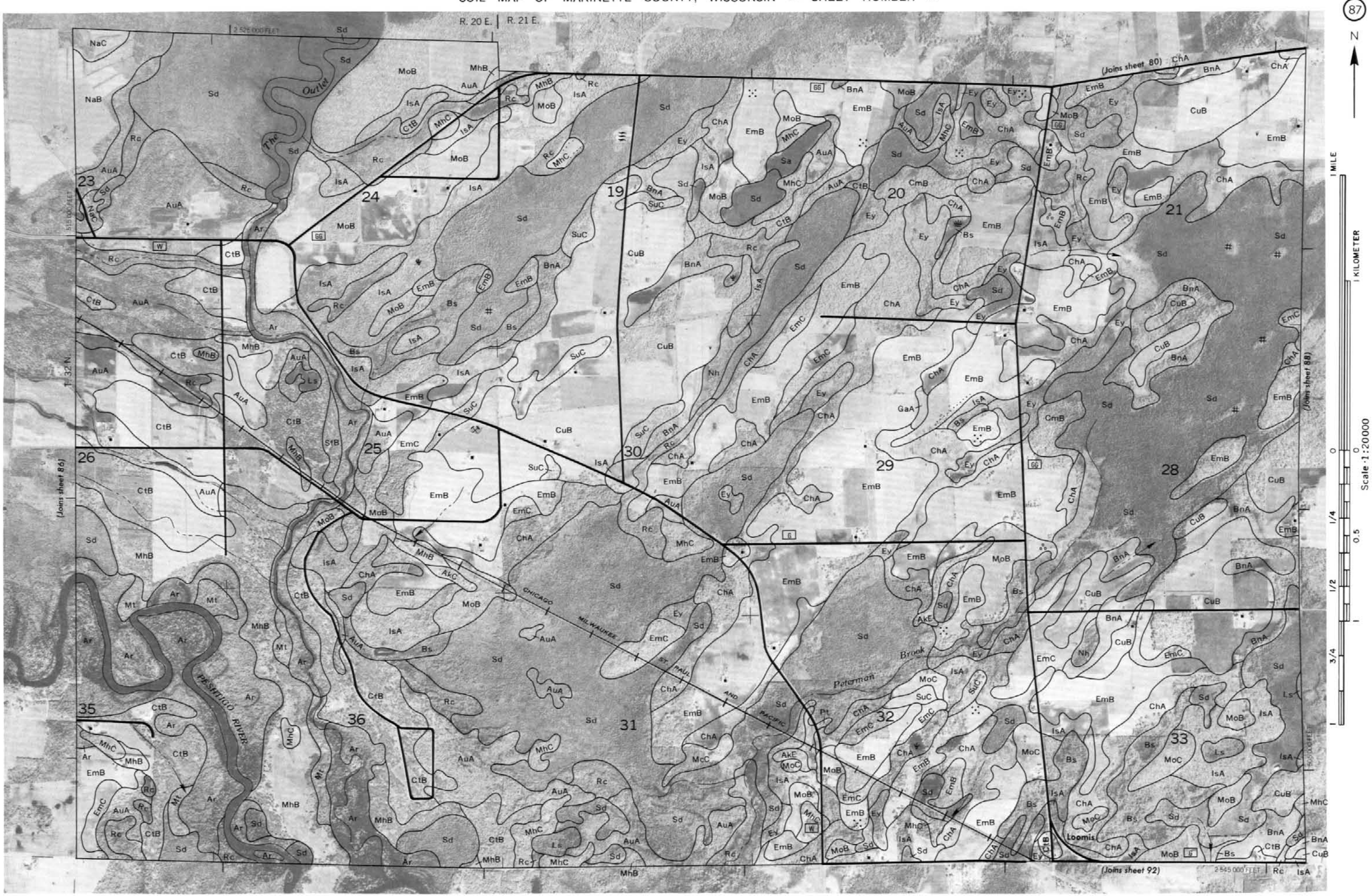

N
(Joins sheet 75)
R. 22 E.
2 590 000 FEET
Twin Island
MENOMINEE RIVER
MICHIGAN
MENOMINEE COUNTY,
T. 32 N
(Joins sheet 81)
(Joins sheet 89)
2 570 000 FEET
530 000 FEET
180
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4


83
N
(Joins sheet 76)
(Joins sheet 84)
R. 18 E.
T. 32 N.
OCONTO COUNTY
OCONTO COUNTY
West Branch Peshtigo Brook
19
20
21
28
29
30
31
32
33
1 MILE
1 KILOMETER
Scale 1:20000
2 450 000 FEET

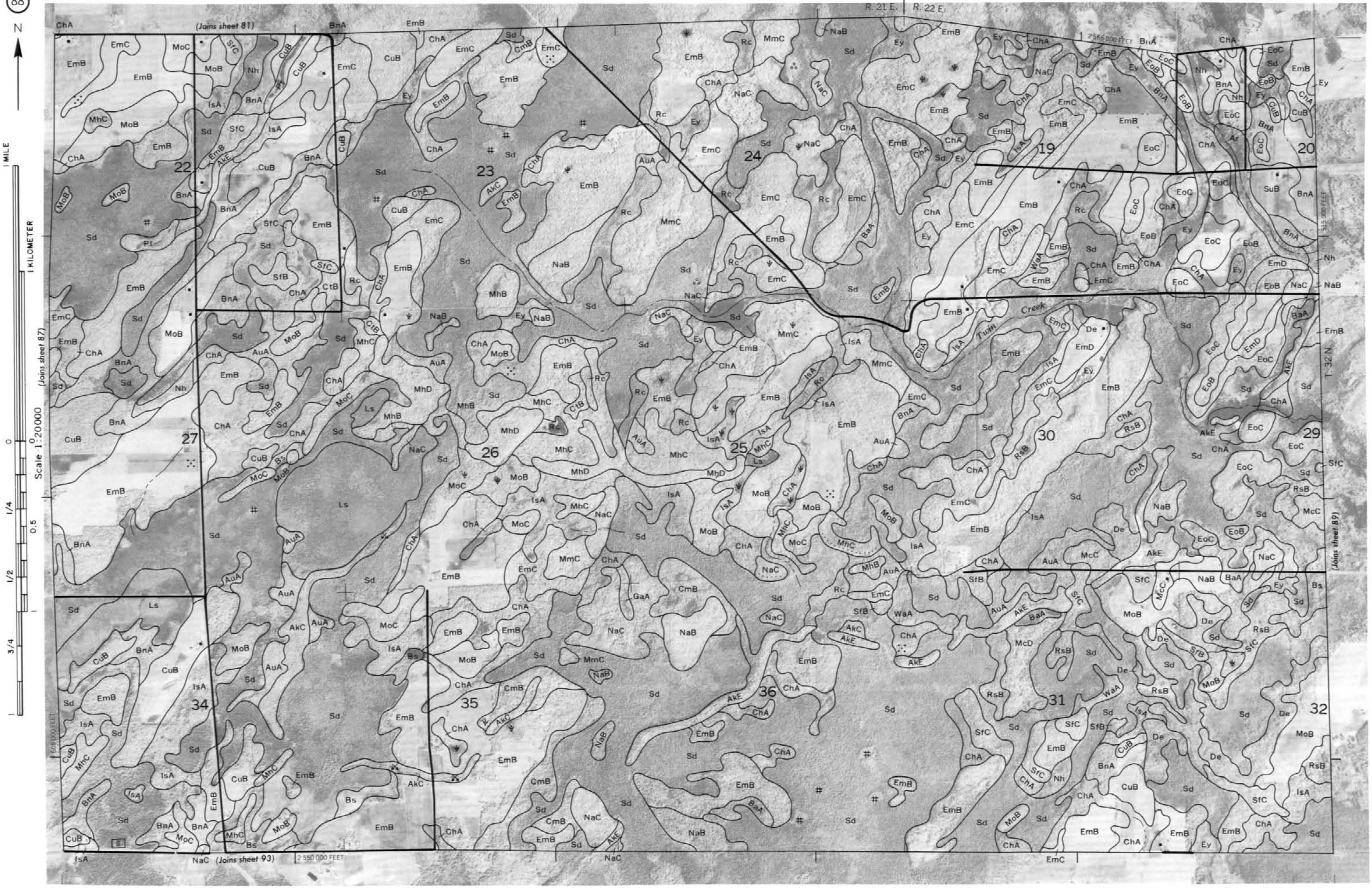

84
N
(Joins sheet 77)
(Joins sheet 83)
(Joins sheet 85)
(Joins sheet 101)
R. 18 E. | R. 19 E.
T. 32 N.
OCONTO COUNTY
Grass Lake
Bullhead Lake
Perch Lake
Mud Lake
North Branch Peshtigo Brook
West Branch Peshtigo Brook
2 475 000 FEET
2 455 000 FEET
505 000 FEET
515 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
19
20
22
23
24
25
26
27
29
30
31
32
34
35
36

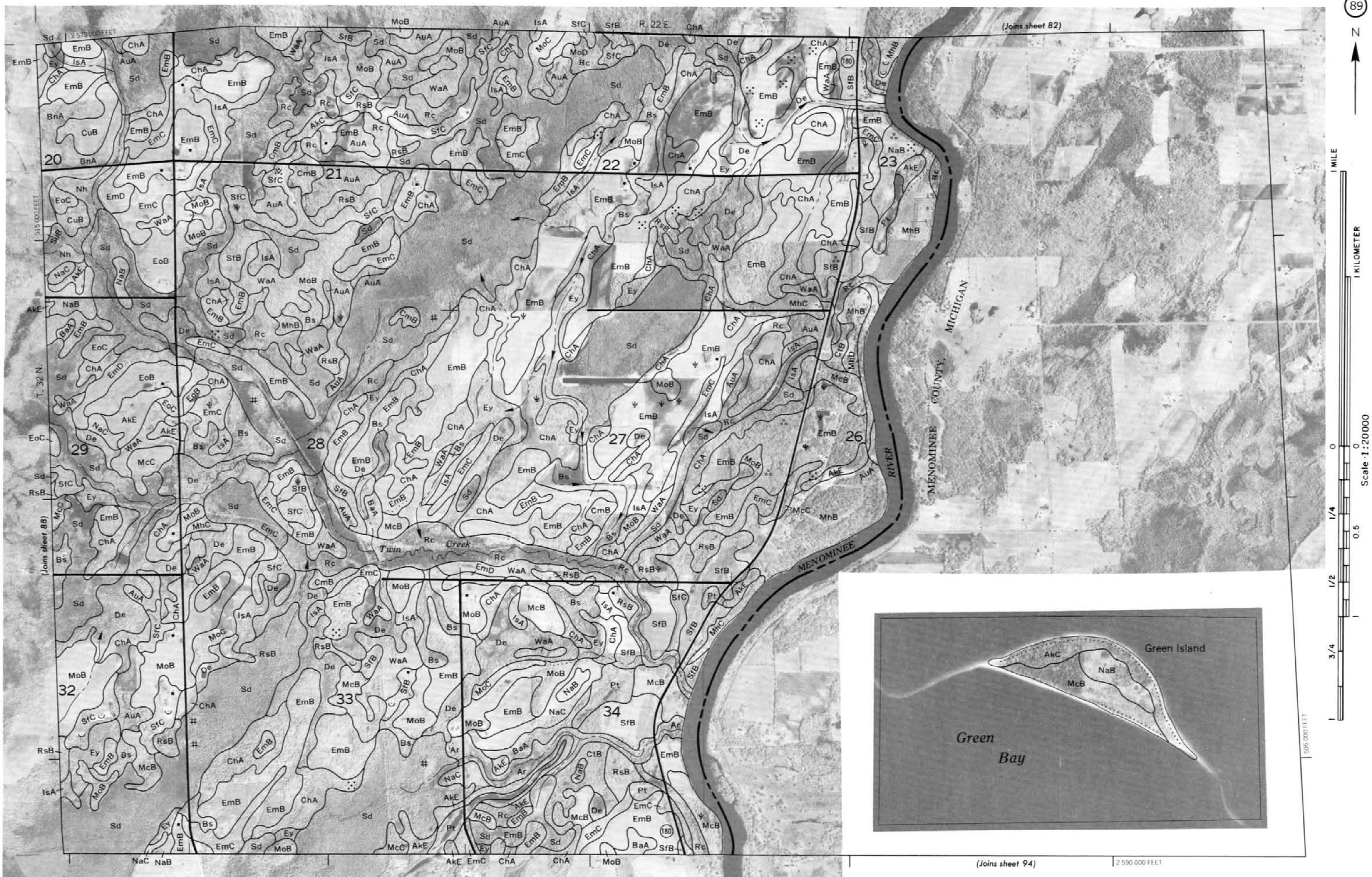

85
N
R. 19 E.
T. 32 N.
2 480 000 FEET
515 000 FEET
2 495 000 FEET
(Joins sheet 78)
(Joins sheet 84)
(Joins sheet 86)
(Joins sheet 90)
Kirby Lake
PESHTIGO RIVER
Sandstone Flowage
Devils Lake
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
1 MILE
1 KILOMETER
Scale 1:20000


86
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
1
(Joins sheet 79)
(Joins sheet 85)
(Joins sheet 87)
(Joins sheet 91)
R. 20 E.
T. 32 N.
2 520 000 FEET
2 500 000 FEET
CRIVITZ
PESHTIGO RIVER
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
LAKE SUPERIOR AND ESCANABA
Marl Lake
Left Foot Lake
Upper Left Foot Creek
water
141
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35

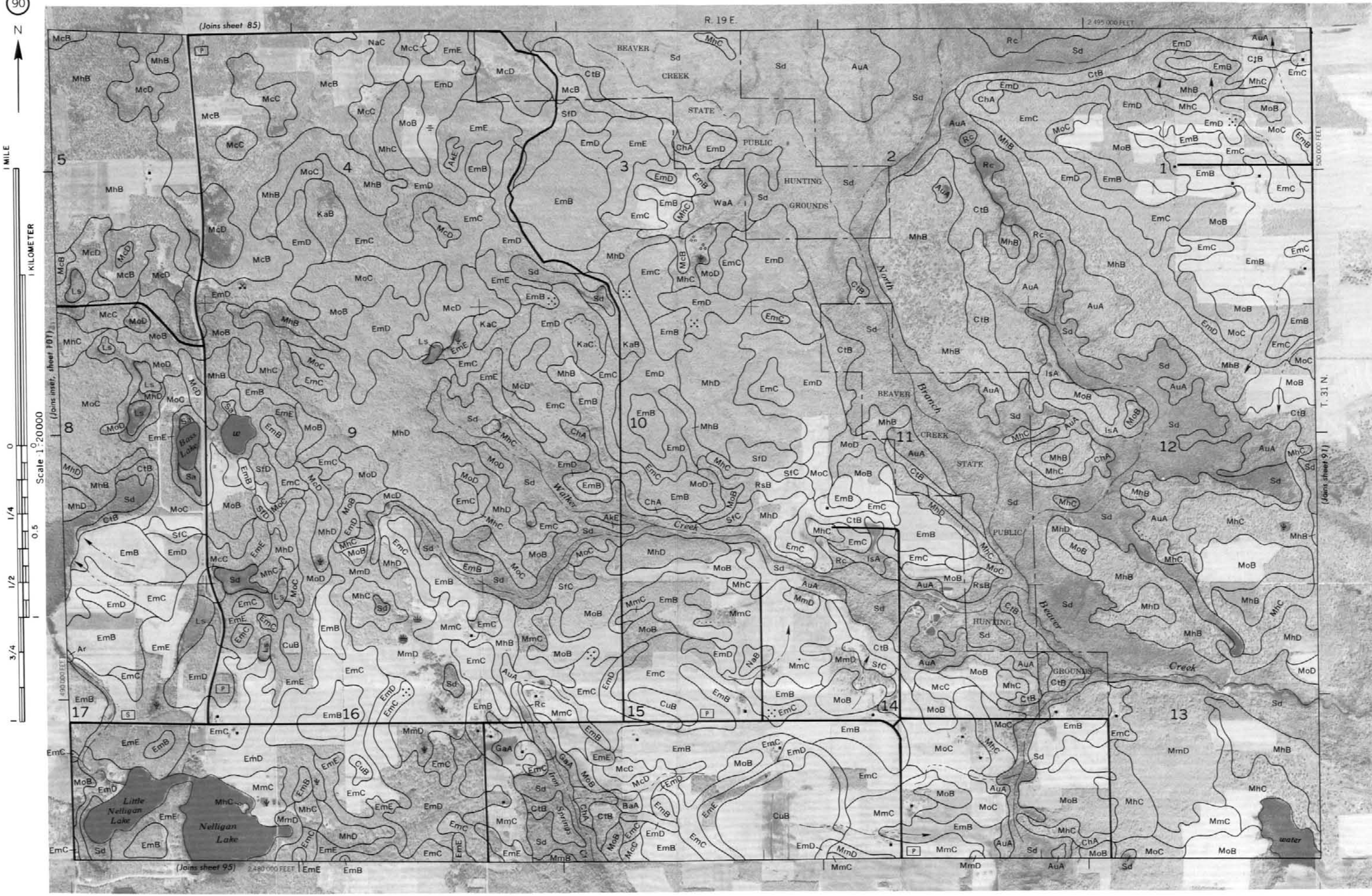

87
N
R. 20 E.
R. 21 E.
T. 32 N.
(Joins sheet 80)
(Joins sheet 86)
(Joins sheet 88)
(Joins sheet 92)
2 525 000 FEET
2 545 000 FEET
The Outlet
PESHTIGO RIVER
Peterman Brook
CHICAGO
MILWAUKEE
ST PAUL
AND
PACIFIC
Loomis
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 88

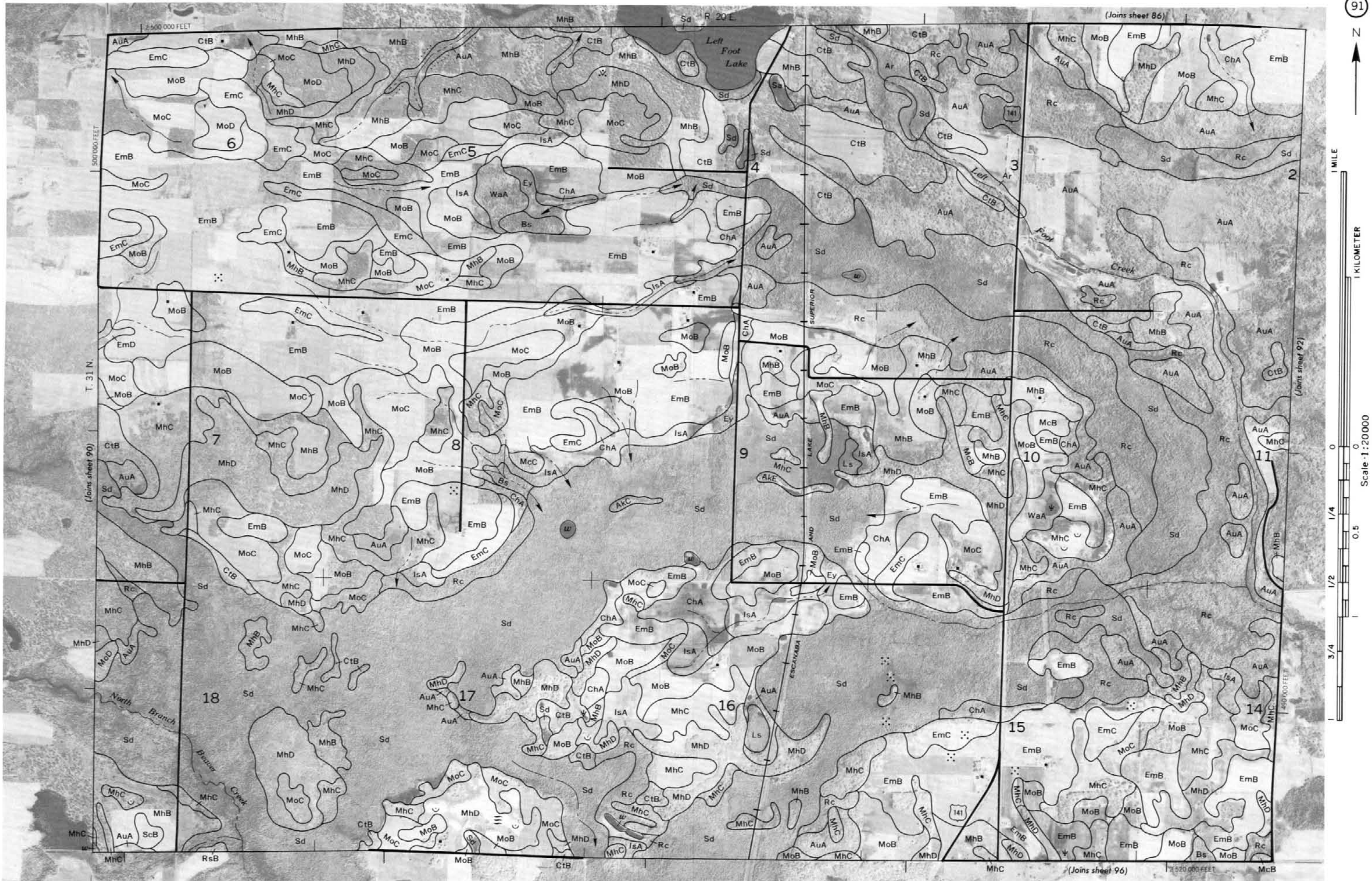


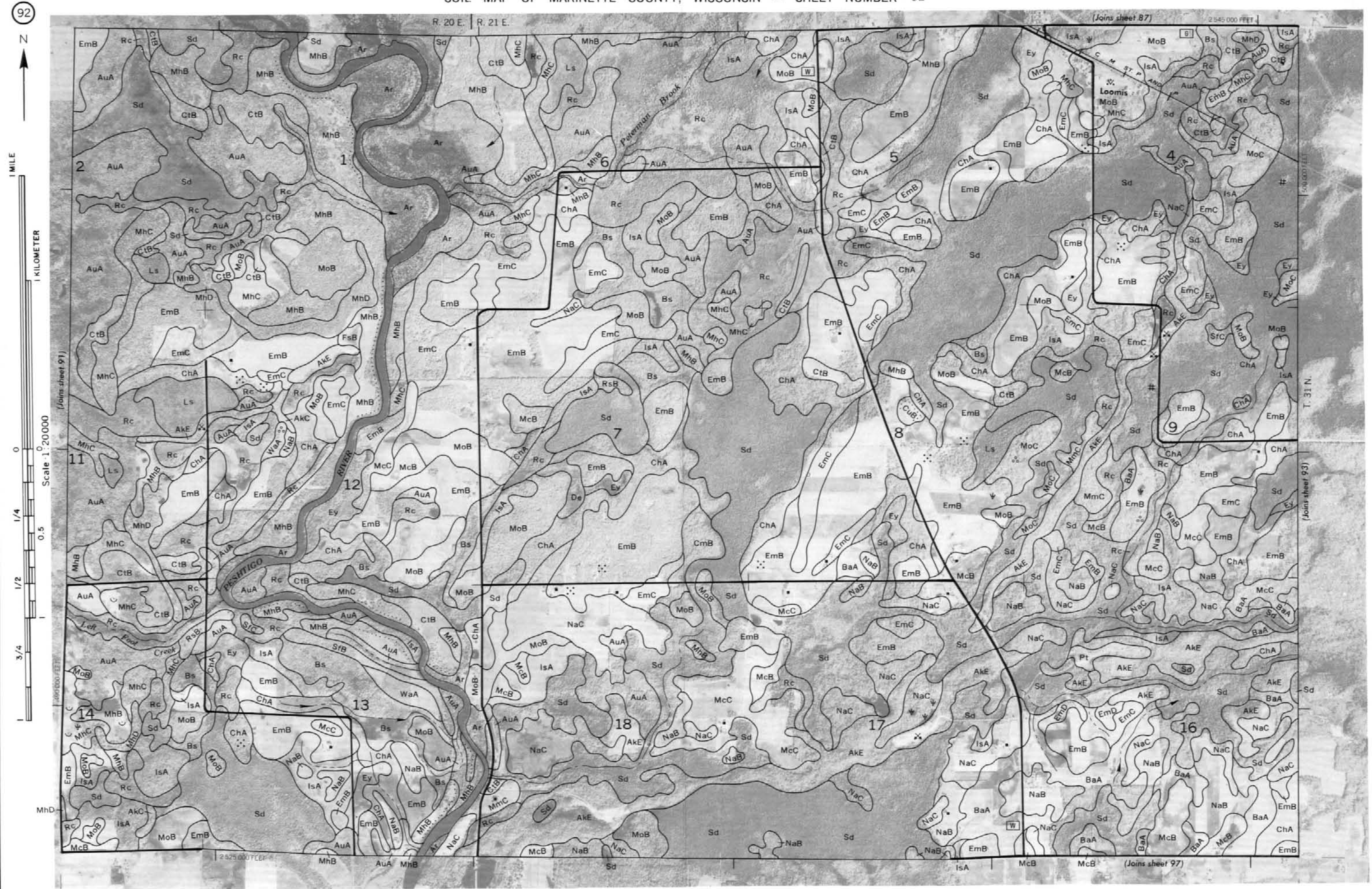

89
N
(Joins sheet 82)
(Joins sheet 88)
(Joins sheet 94)
R. 22 E.
T. 32 N.
2 570 000 FEET
2 590 000 FEET
515 000 FEET
505 000 FEET
Twin Creek
MENOMINEE RIVER
MENOMINEE COUNTY, MICHIGAN
Green Island
Green Bay
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
20
21
22
23
26
27
28
29
32
33
34
180

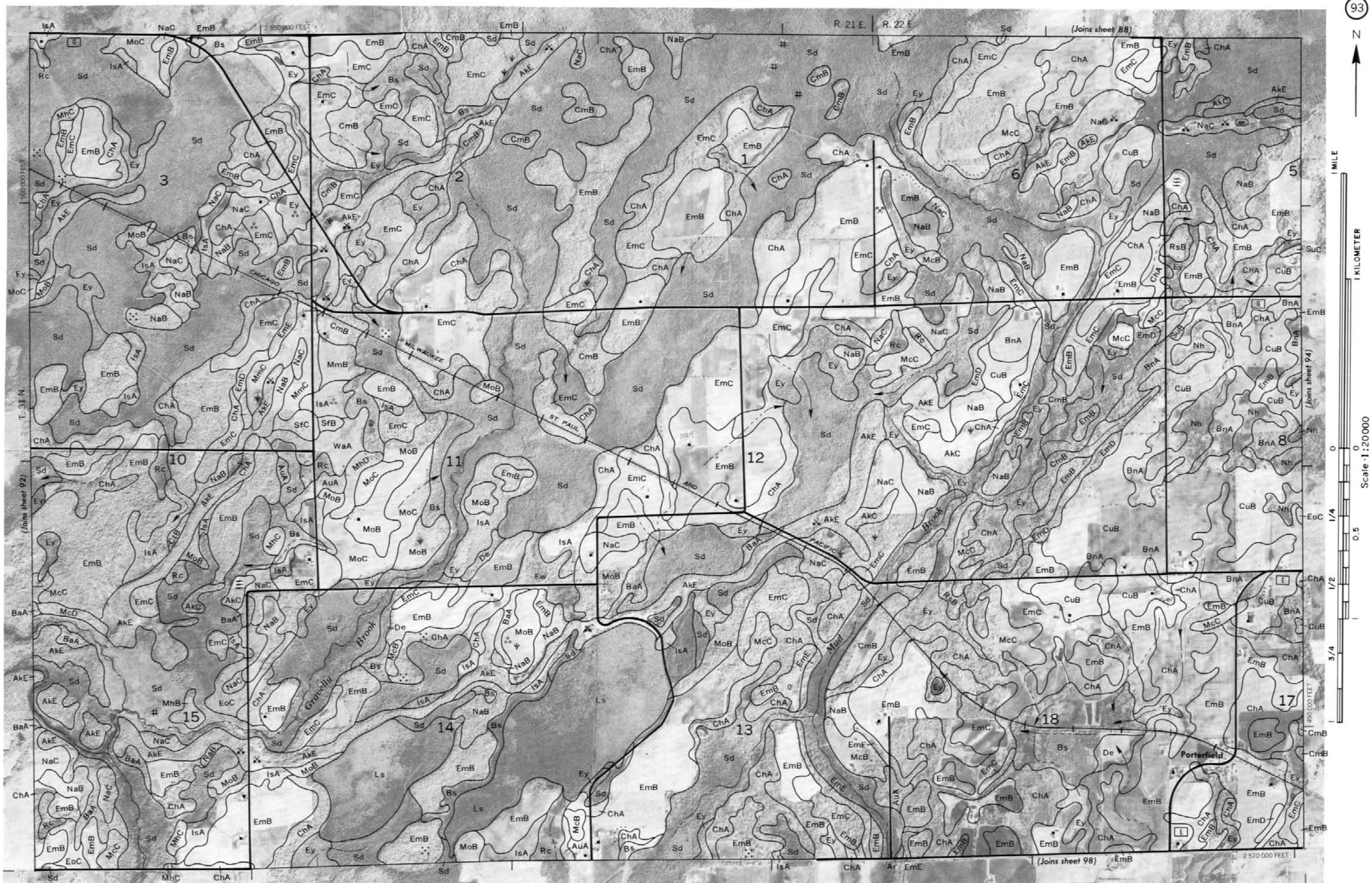
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 90

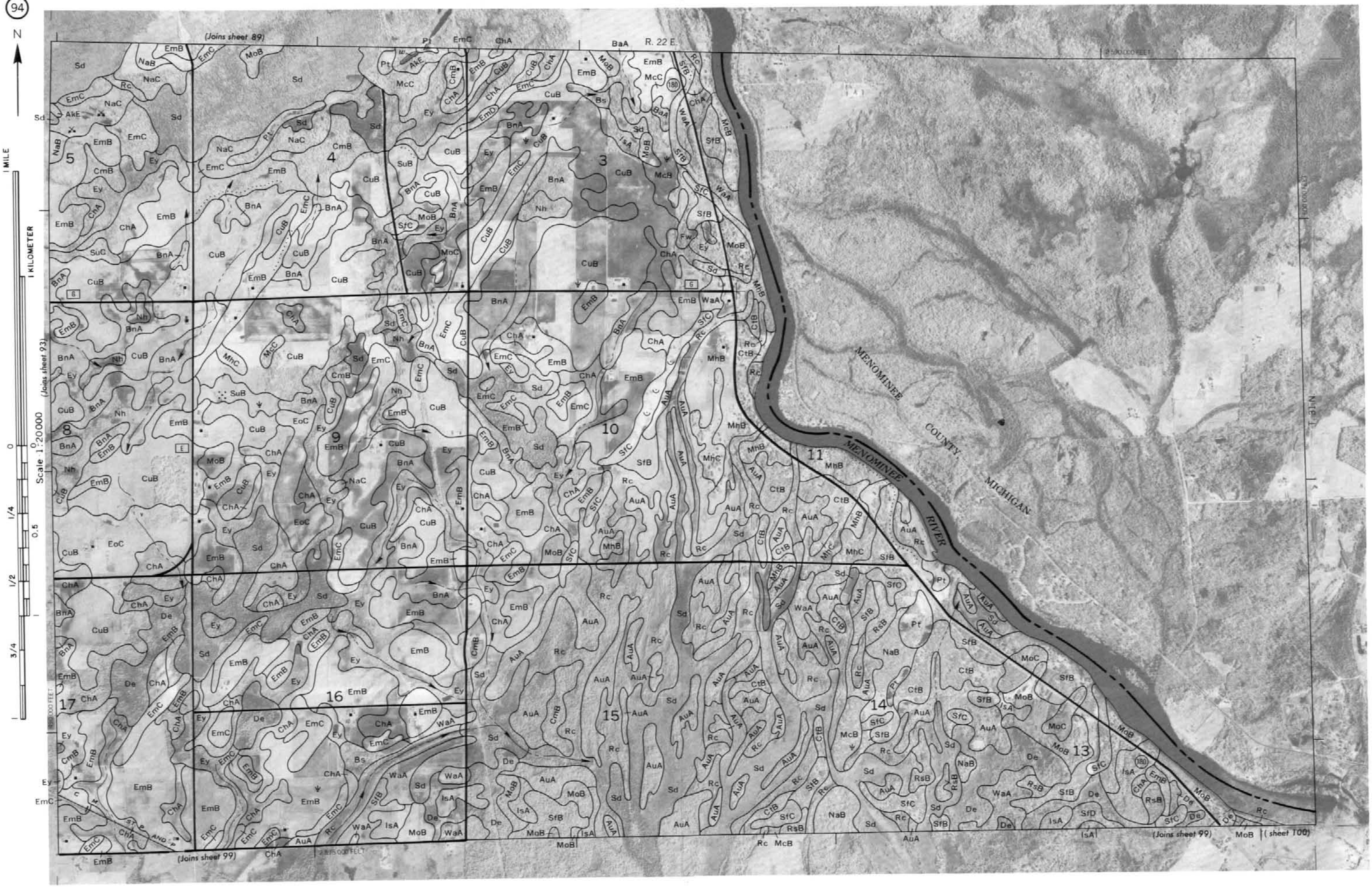


SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 91

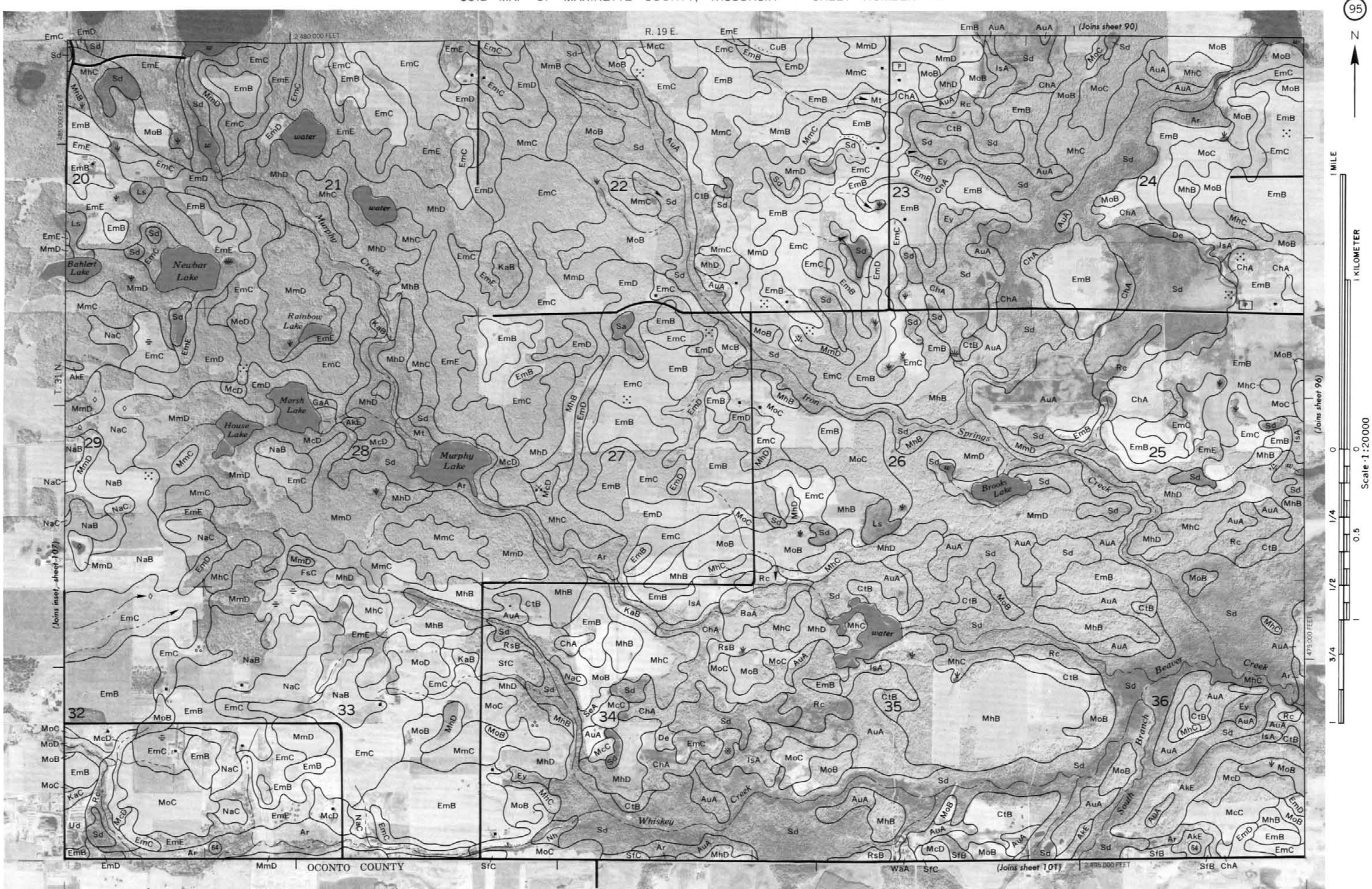



92
N
1 MILE
1 KILOMETER
Scale 1:20000
R. 20 E.
R. 21 E.
(Joins sheet 87)
(Joins sheet 91)
(Joins sheet 93)
(Joins sheet 97)
T. 31 N.
Peterman Brook
PESHTIGO RIVER
Left Foot Creek
Loomis
2 545 000 FEET
2 525 000 FEET


93
N
(Joins sheet 88)
(Joins sheet 94)
(Joins sheet 98)
(Joins sheet 92)
R. 21 E.
R. 22 E.
T. 31 N.
2 550 000 FEET
2 570 000 FEET
400 000 FEET
CHICAGO
MILWAUKEE
ST. PAUL
AND
PACIFIC
Gravelly Brook
Mud Brook
Porterfield
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

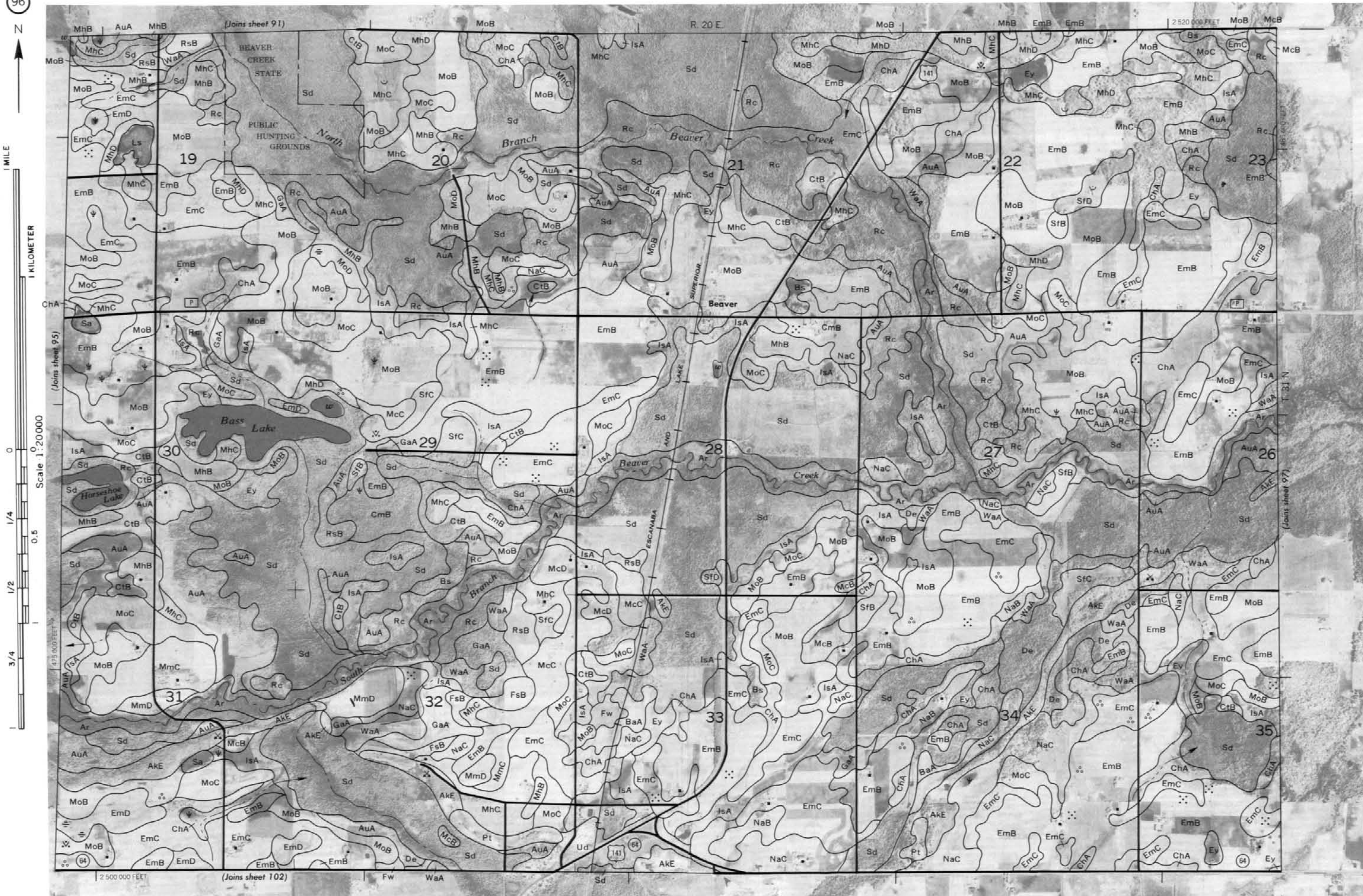

94
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 89)
(Joins sheet 93)
(Joins sheet 99)
(Joins sheet 99)
(sheet 100)
R. 22 E.
T. 31 N.
MENOMINEE RIVER
MENOMINEE COUNTY, MICHIGAN

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 95

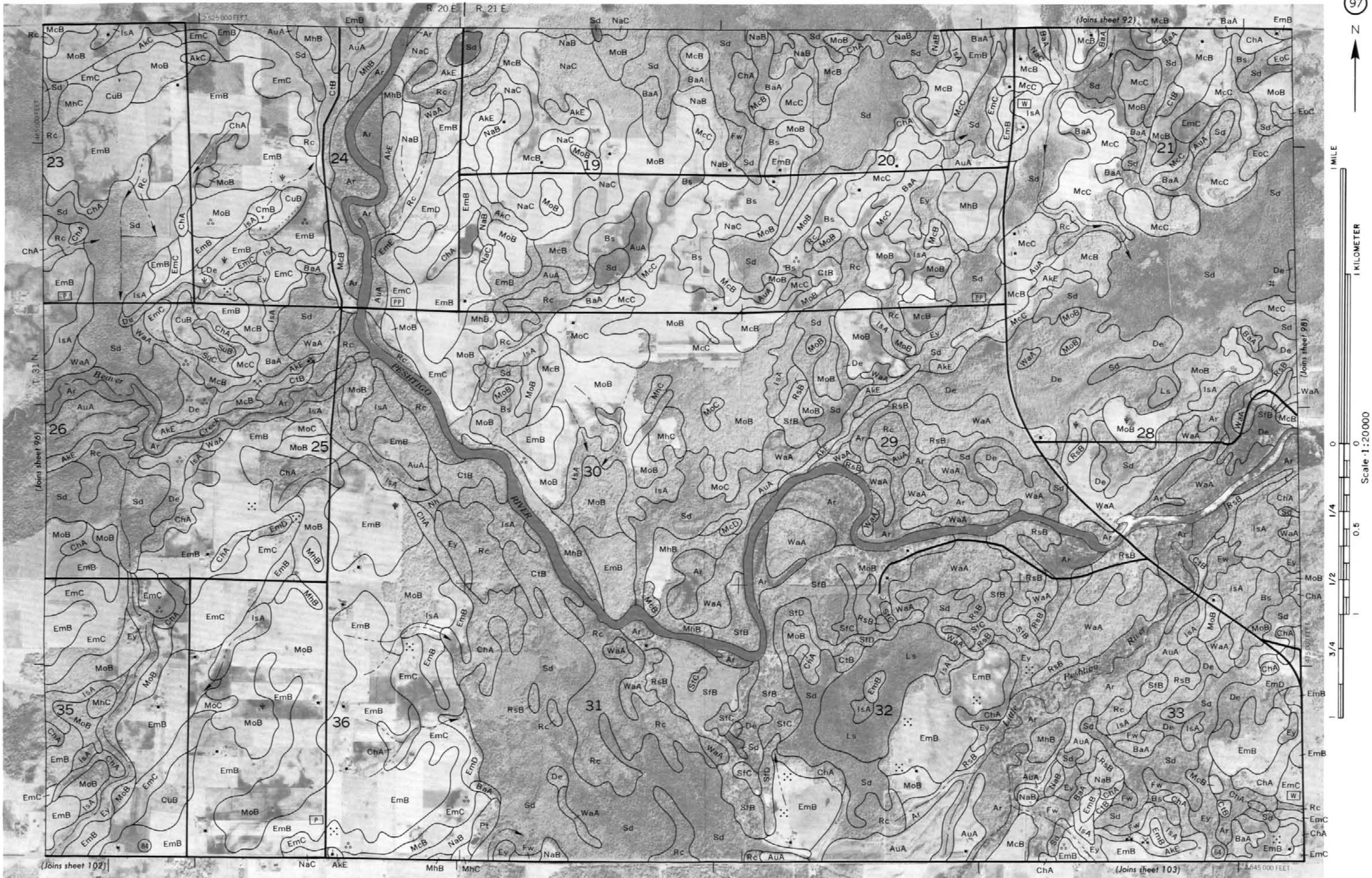


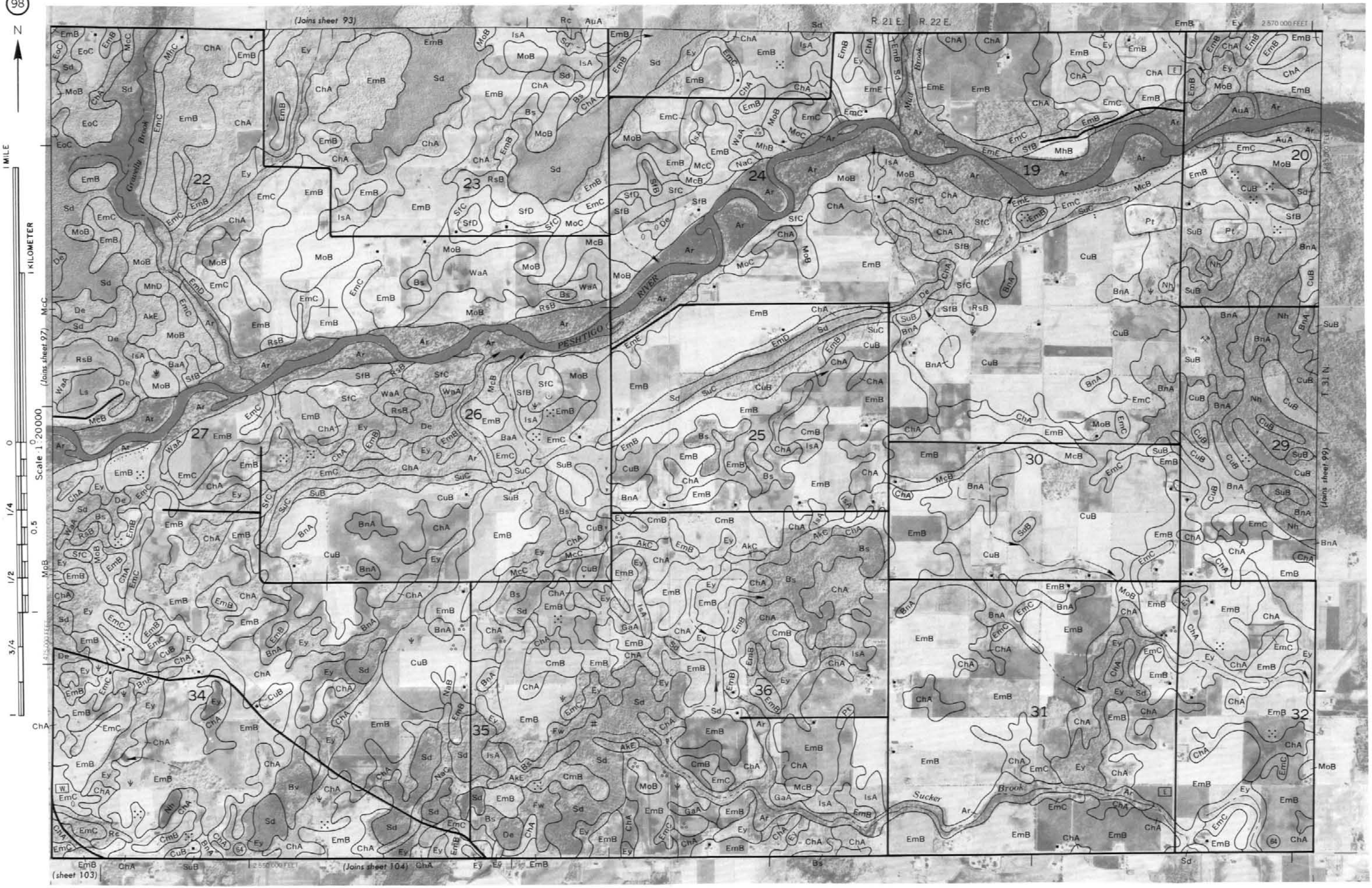
96

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 96

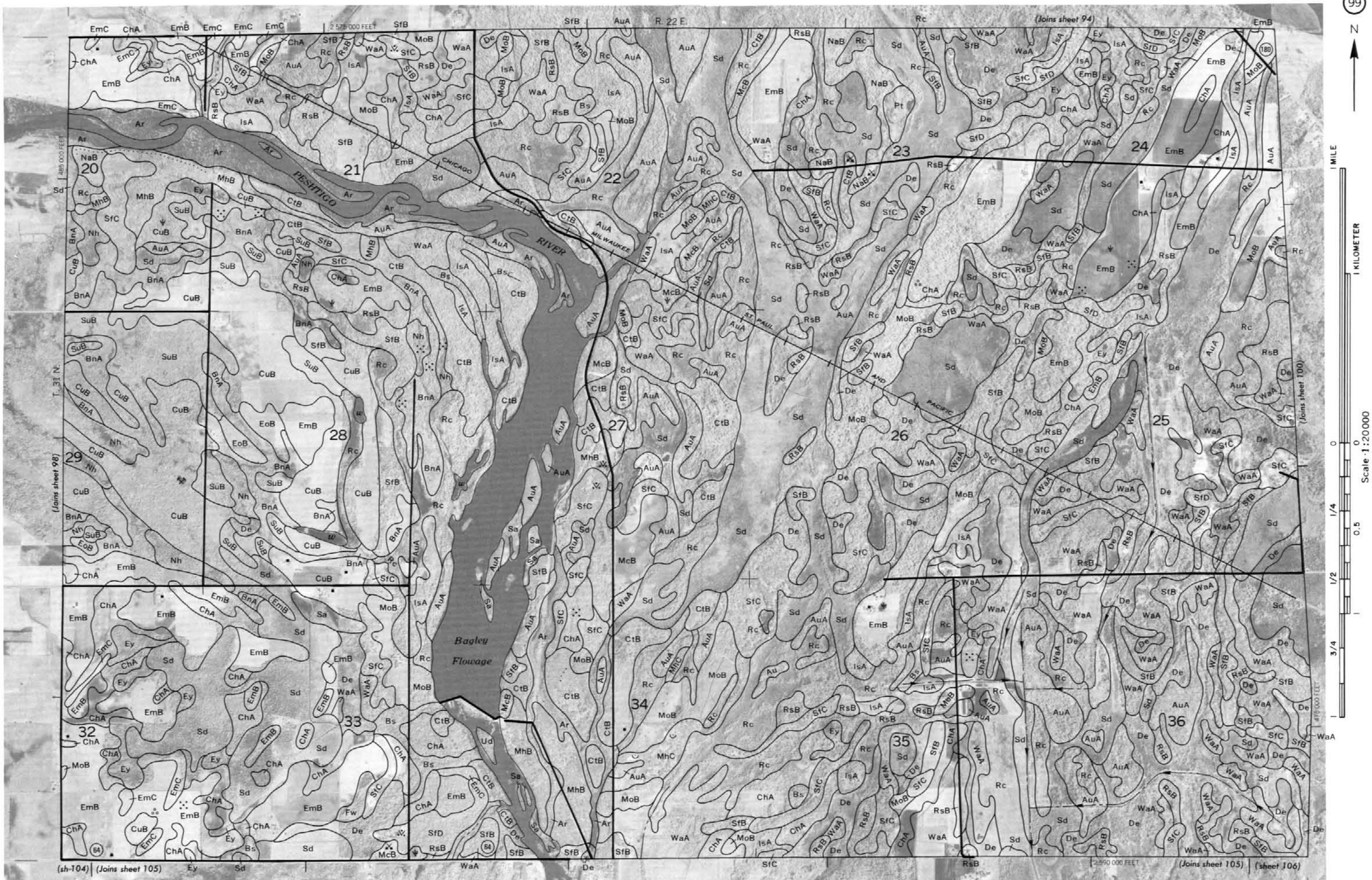


SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 97

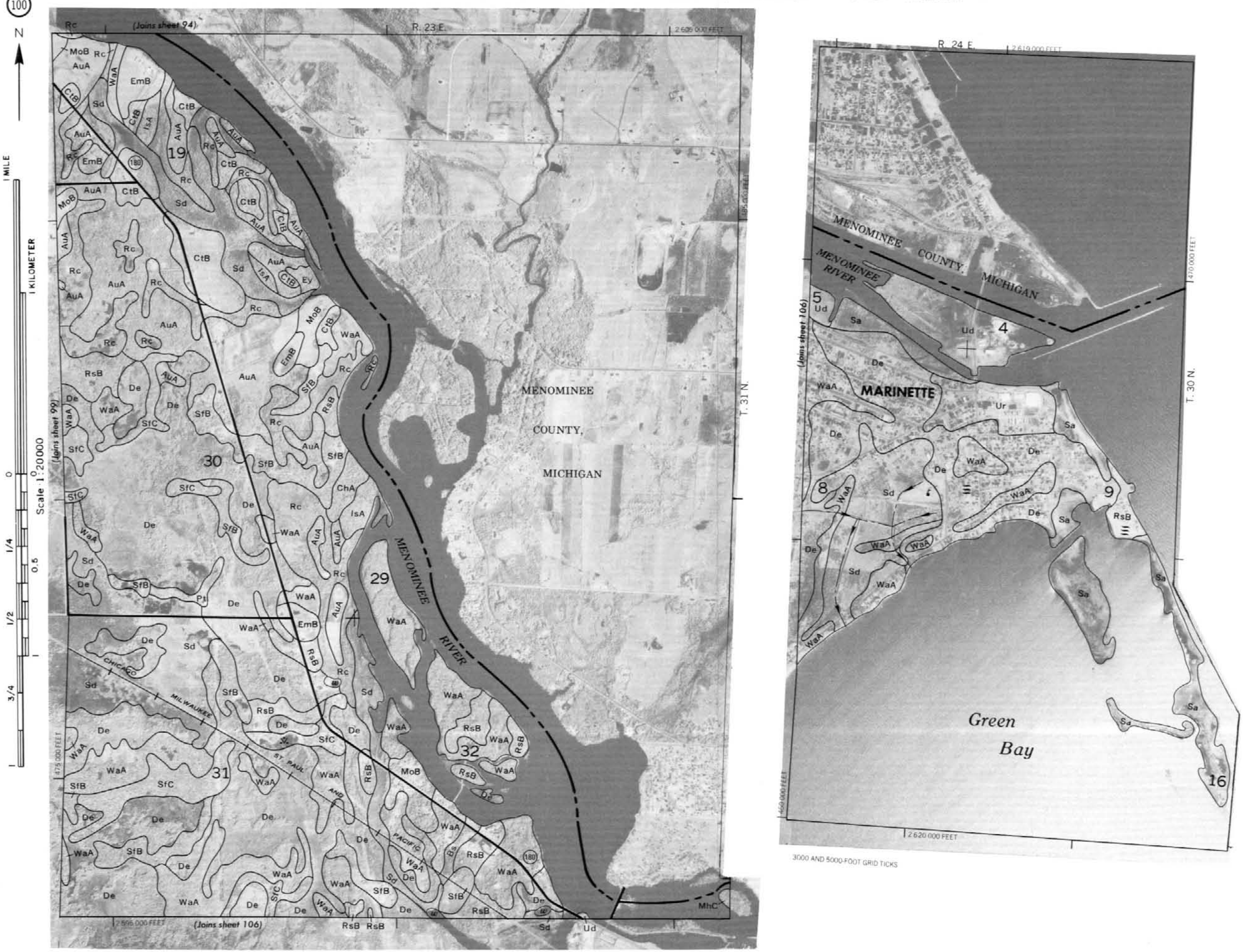


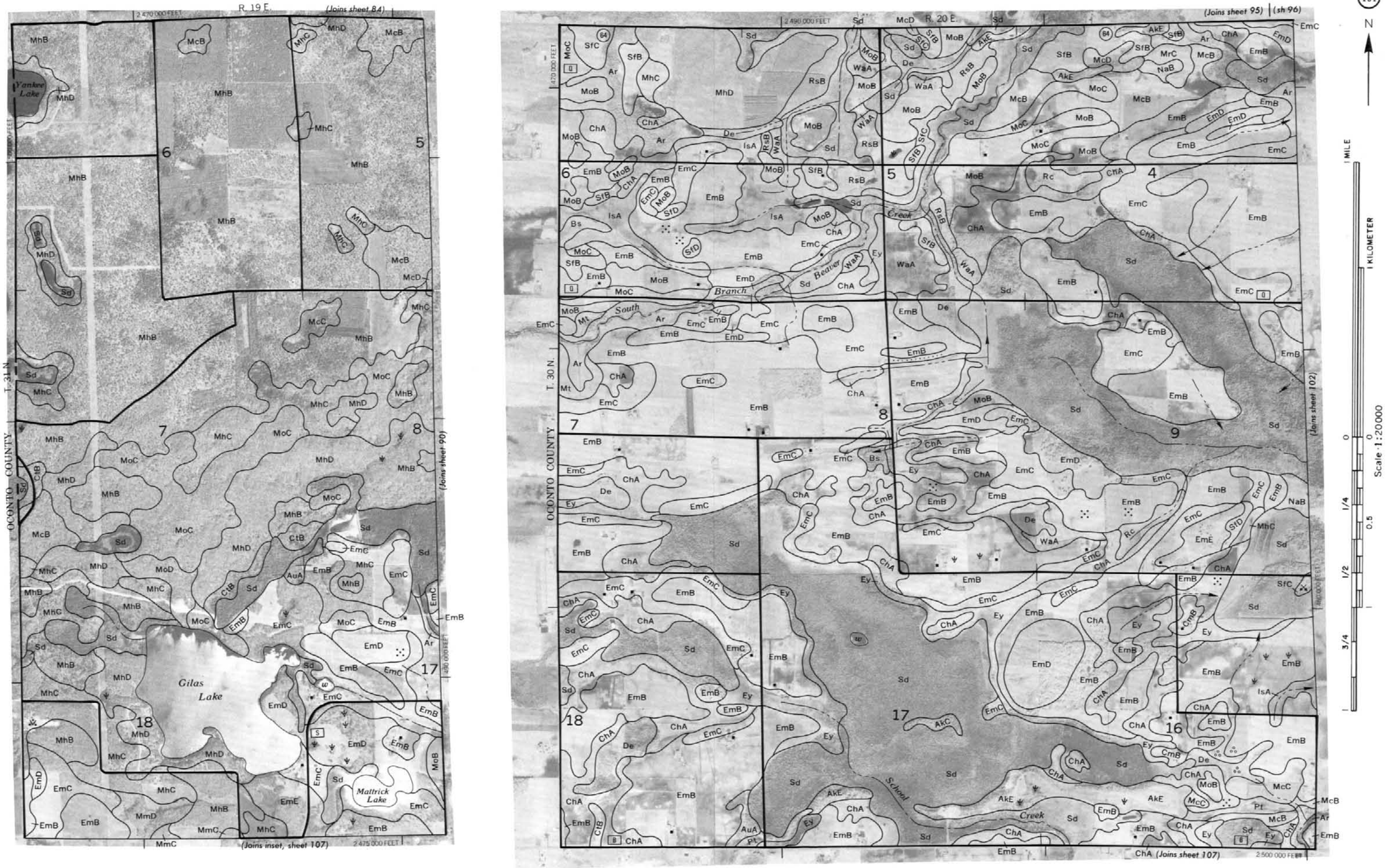

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
(Joins sheet 93)
(Joins sheet 97)
(Joins sheet 99)
(Joins sheet 104)
(sheet 103)
R. 21 E.
R. 22 E.
T. 31 N.
2 570 000 FEET
2 550 000 FEET
PESHTIGO RIVER
Gravelly Brook
Mud Brook
Sucker Brook
19
20
22
23
24
25
26
27
29
30
31
32
34
35
36
64

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 99

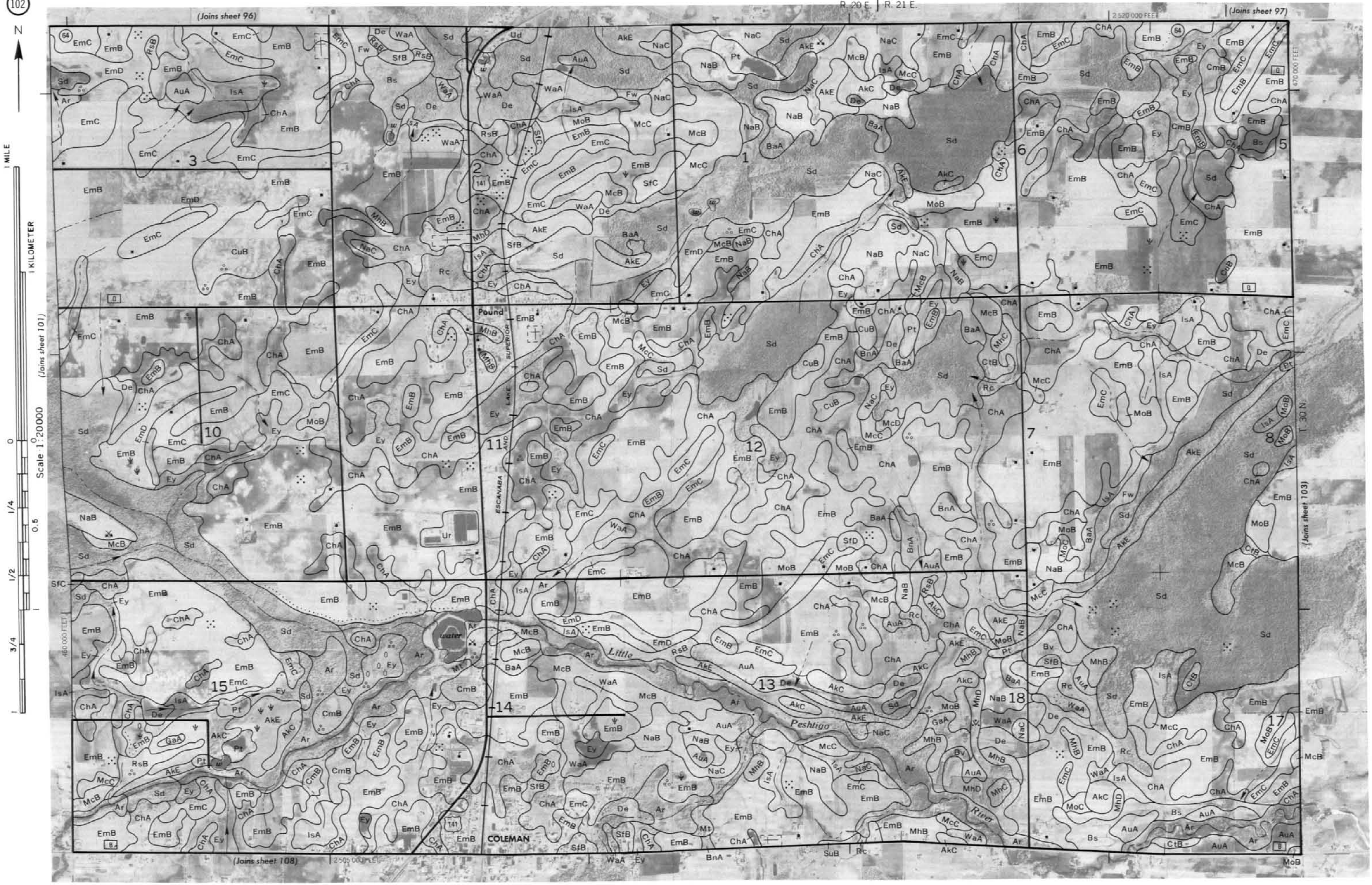


SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 100

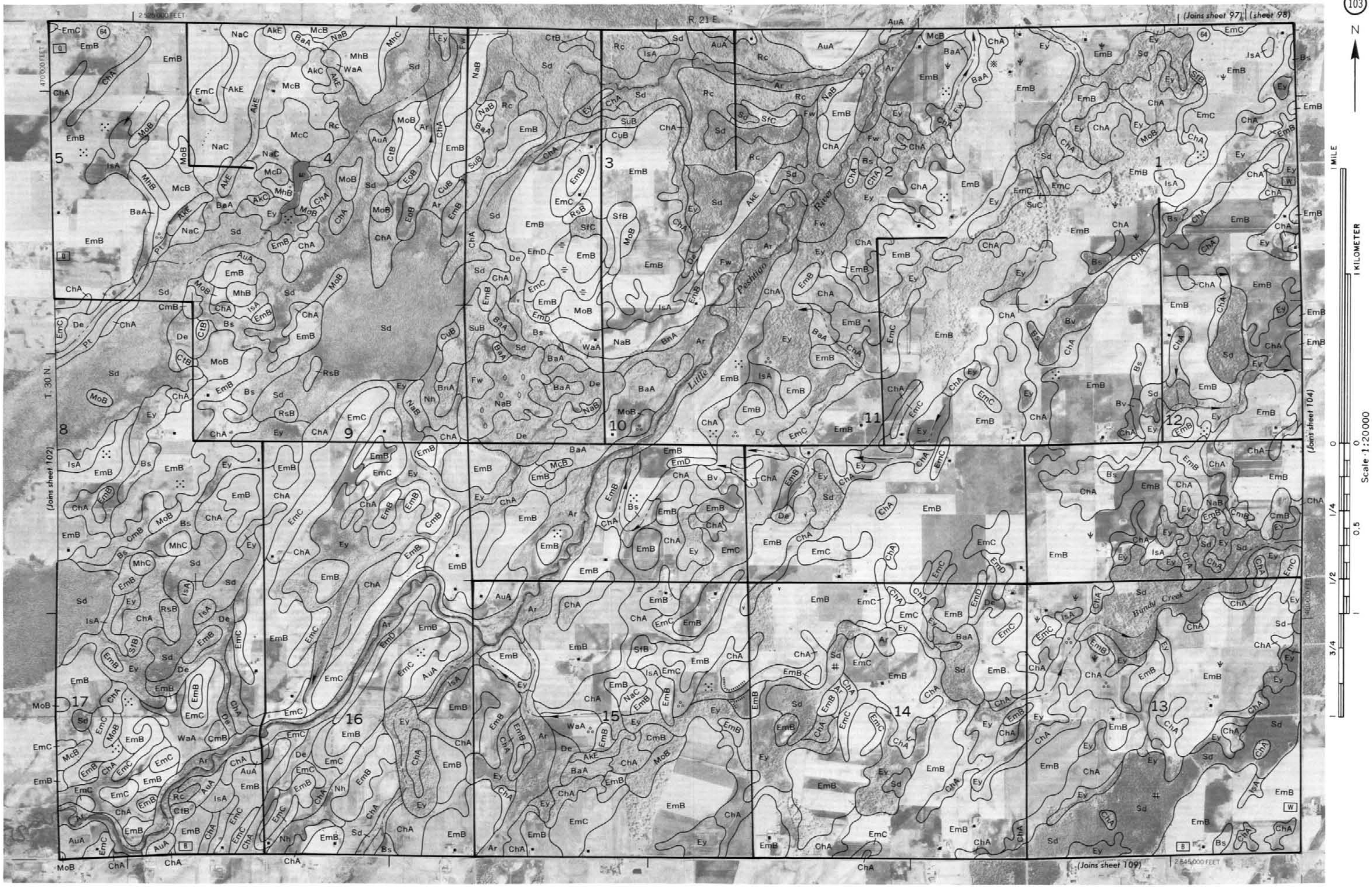


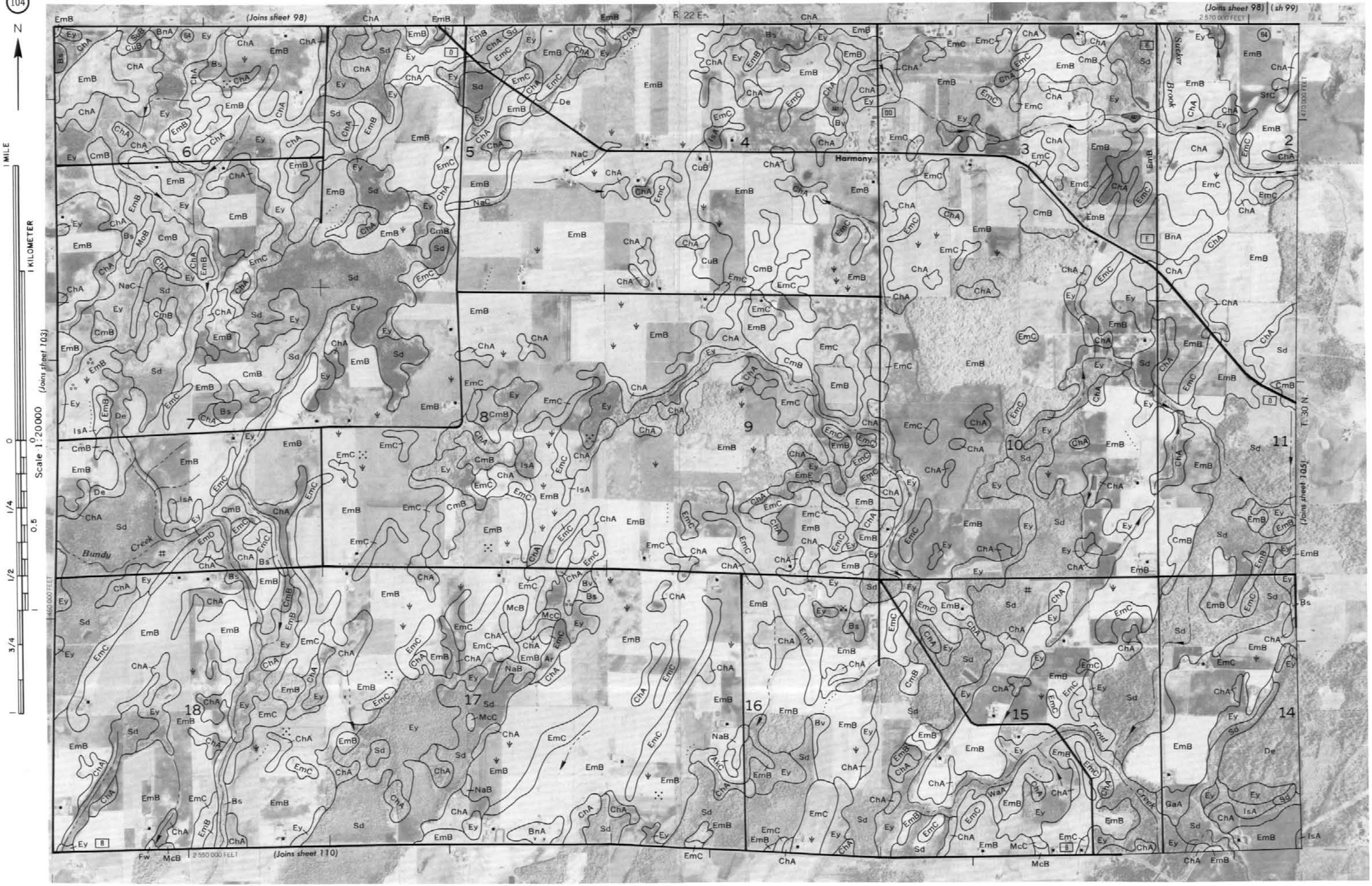

101
N
R. 19 E.
(Joins sheet 84)
2 470 000 FEET
Yankee Lake
Gilas Lake
Mattrick Lake
T. 31 N.
OCONTO COUNTY
(Joins sheet 90)
(Joins inset, sheet 107)
2 475 000 FEET
R. 20 E.
2 490 000 FEET
(Joins sheet 95)
(sh 96)
470 000 FEET
T. 30 N.
OCONTO COUNTY
South Branch
Beaver Creek
School Creek
(Joins sheet 102)
ChA (Joins sheet 107)
2 500 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

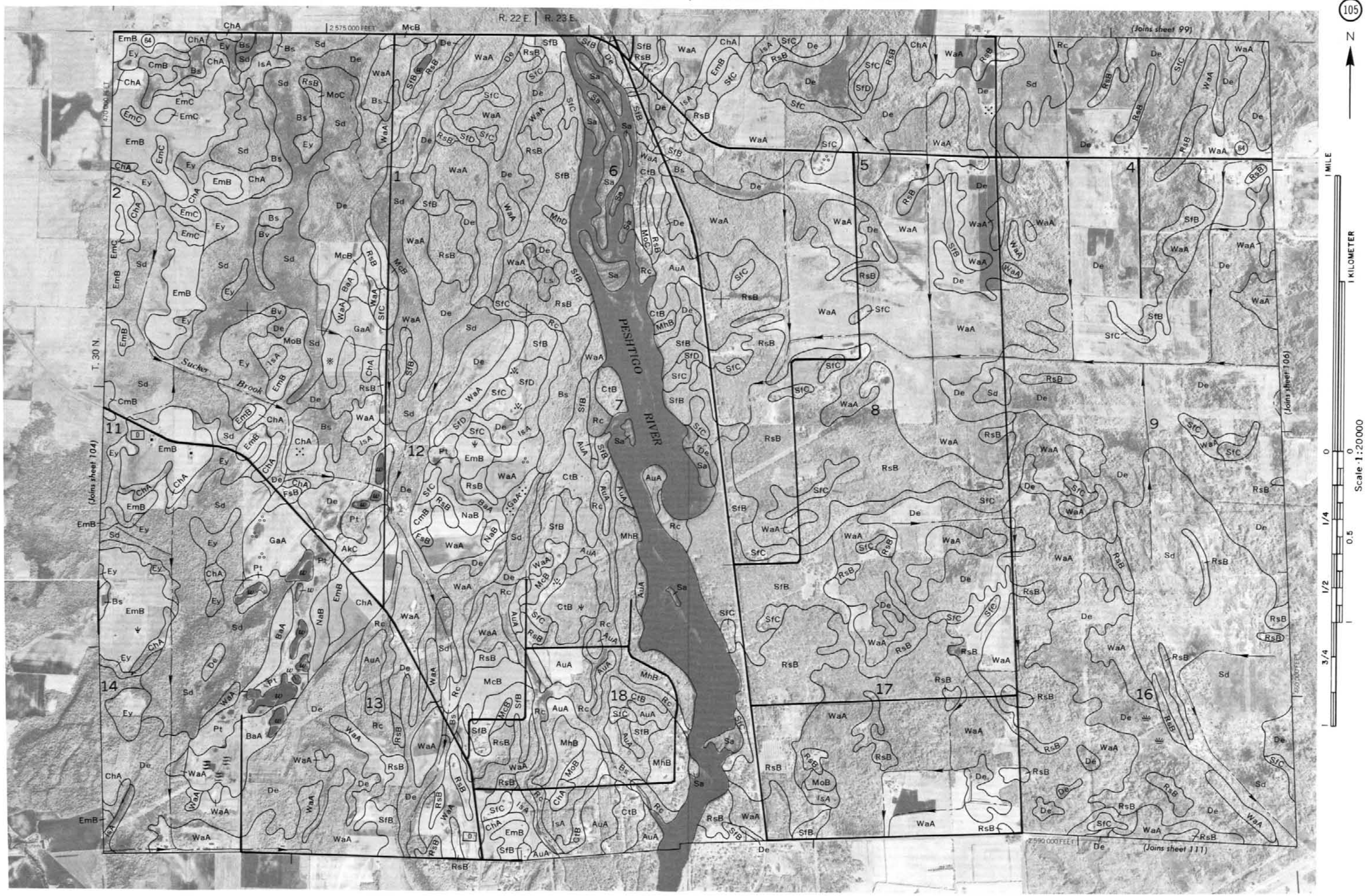
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 102

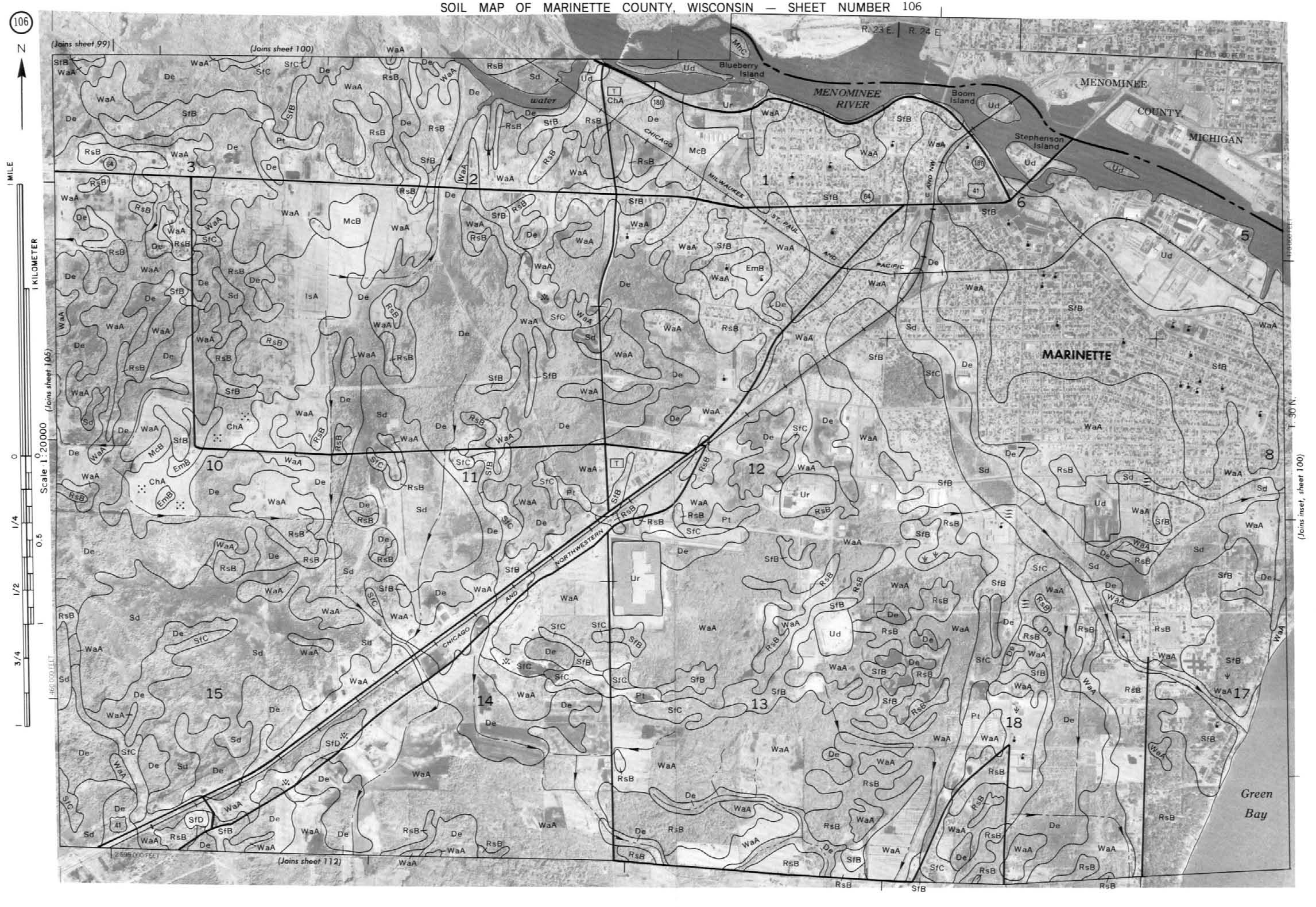


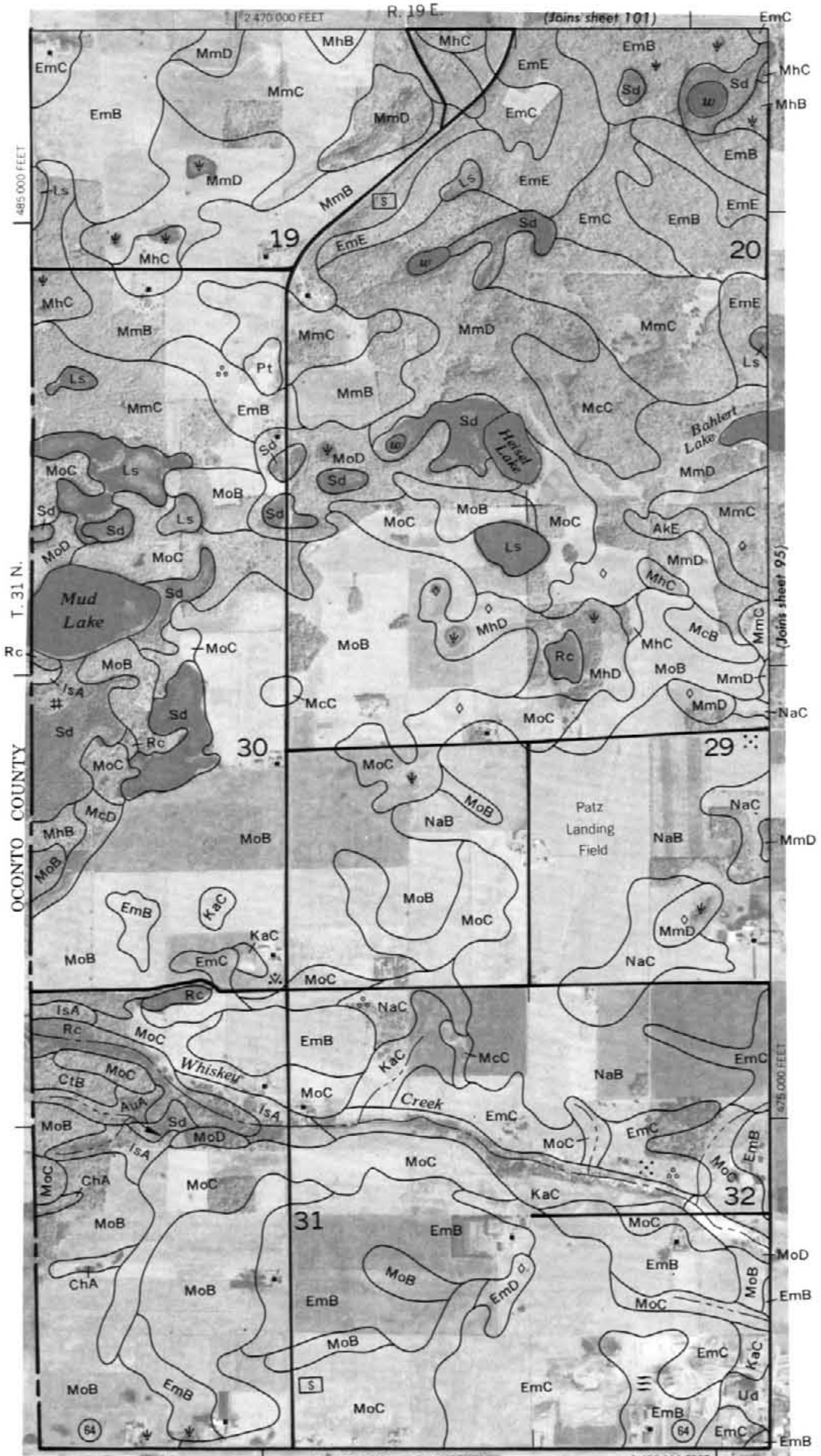
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 103

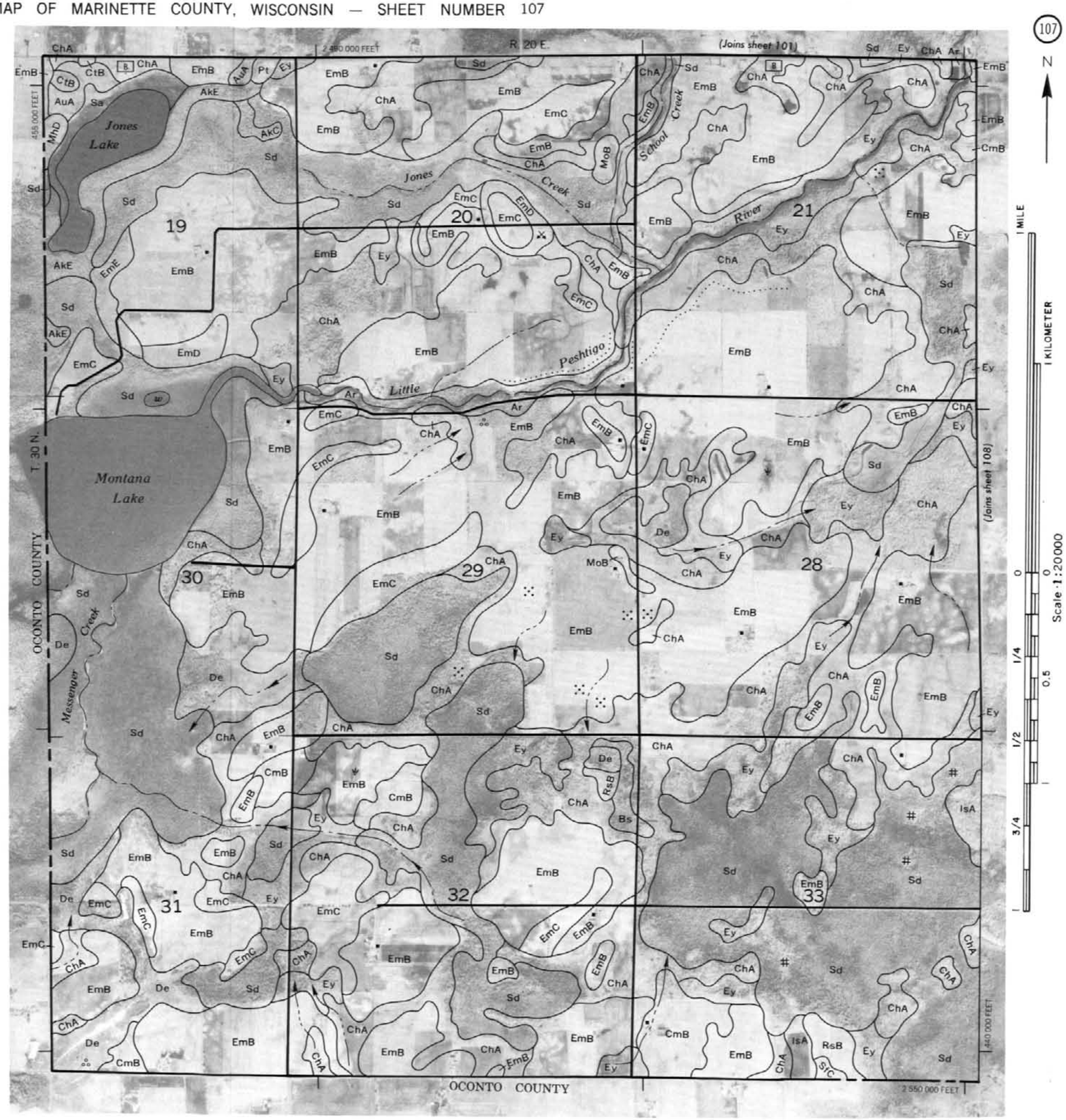



N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
1
(Joins sheet 98)
(sh 99)
R. 22 E.
2 570 000 FEET
470 000 FEET
460 000 FEET
2 550 000 FEET
(Joins sheet 103)
(Joins sheet 105)
(Joins sheet 110)
T. 30 N.
Harmony
Sucker Brook
Bundy Creek
Trout Creek
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18
EmB
EmC
EmD
EmE
ChA
CmB
Ey
Sd
Bs
BnA
CuB
SuB
MoB
NaC
NaB
McB
McC
De
IsA
Bv
Ar
AkC
GaA
WaA
StC
Fw
64
D
DD
E
B

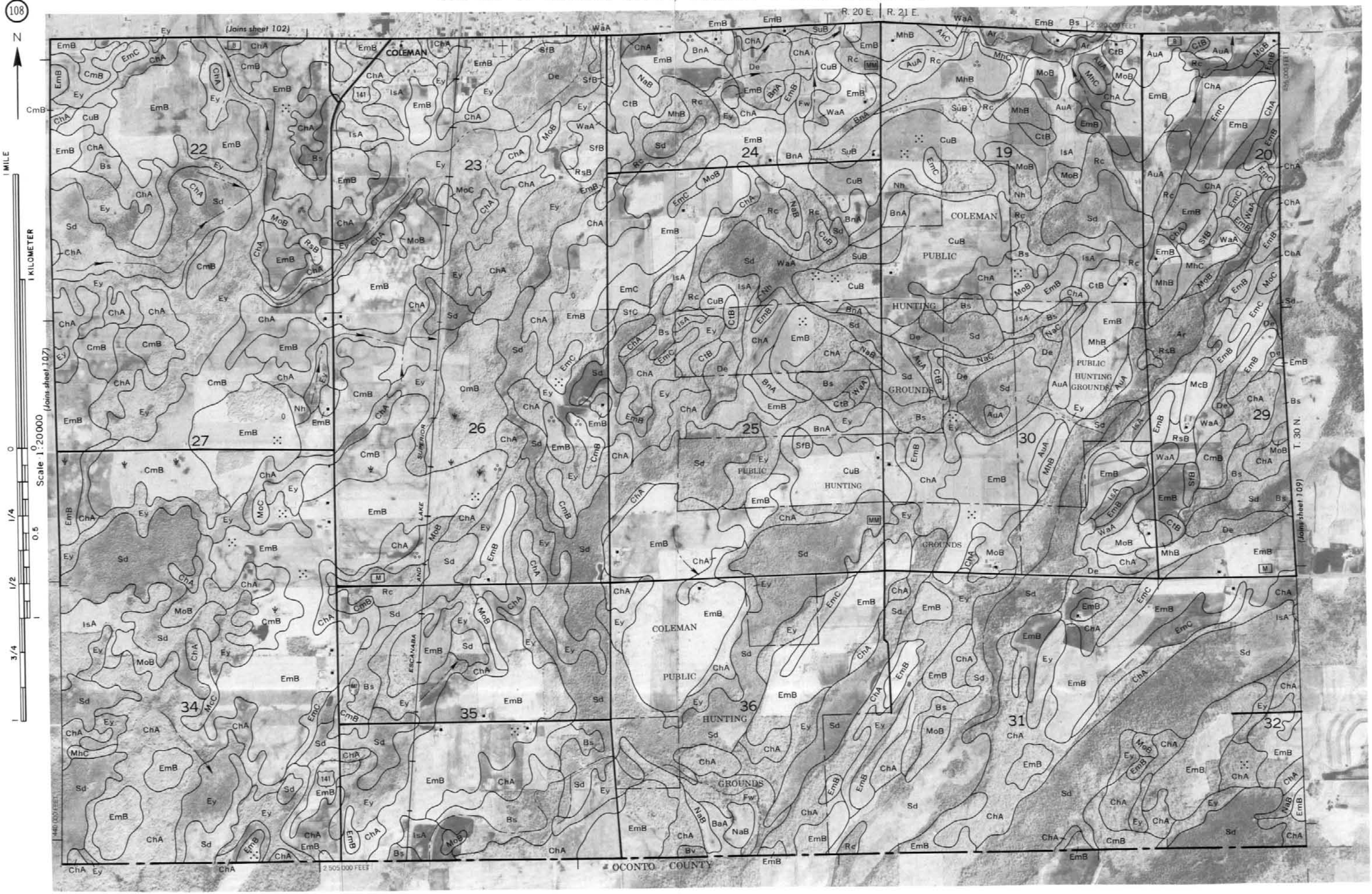

105
R. 22 E.
R. 23 E.
2 575 000 FEET
(Joins sheet 99)
(Joins sheet 104)
(Joins sheet 106)
(Joins sheet 111)
T. 30 N.
PESHTIGO RIVER
Sucker Brook
2 590 000 FEET
N
1 MILE
1 KILOMETER
Scale 1:20000


106
N
(Joins sheet 99)
(Joins sheet 100)
(Joins sheet 105)
(Joins sheet 112)
(Joins inset, sheet 100)
R. 23 E. | R. 24 E.
T. 30 N.
MENOMINEE RIVER
MENOMINEE
COUNTY,
MICHIGAN
MARINETTE
Blueberry Island
Boom Island
Stephenson Island
water
Green Bay
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
CHICAGO AND NORTHWESTERN
C AND NW
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
1
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18

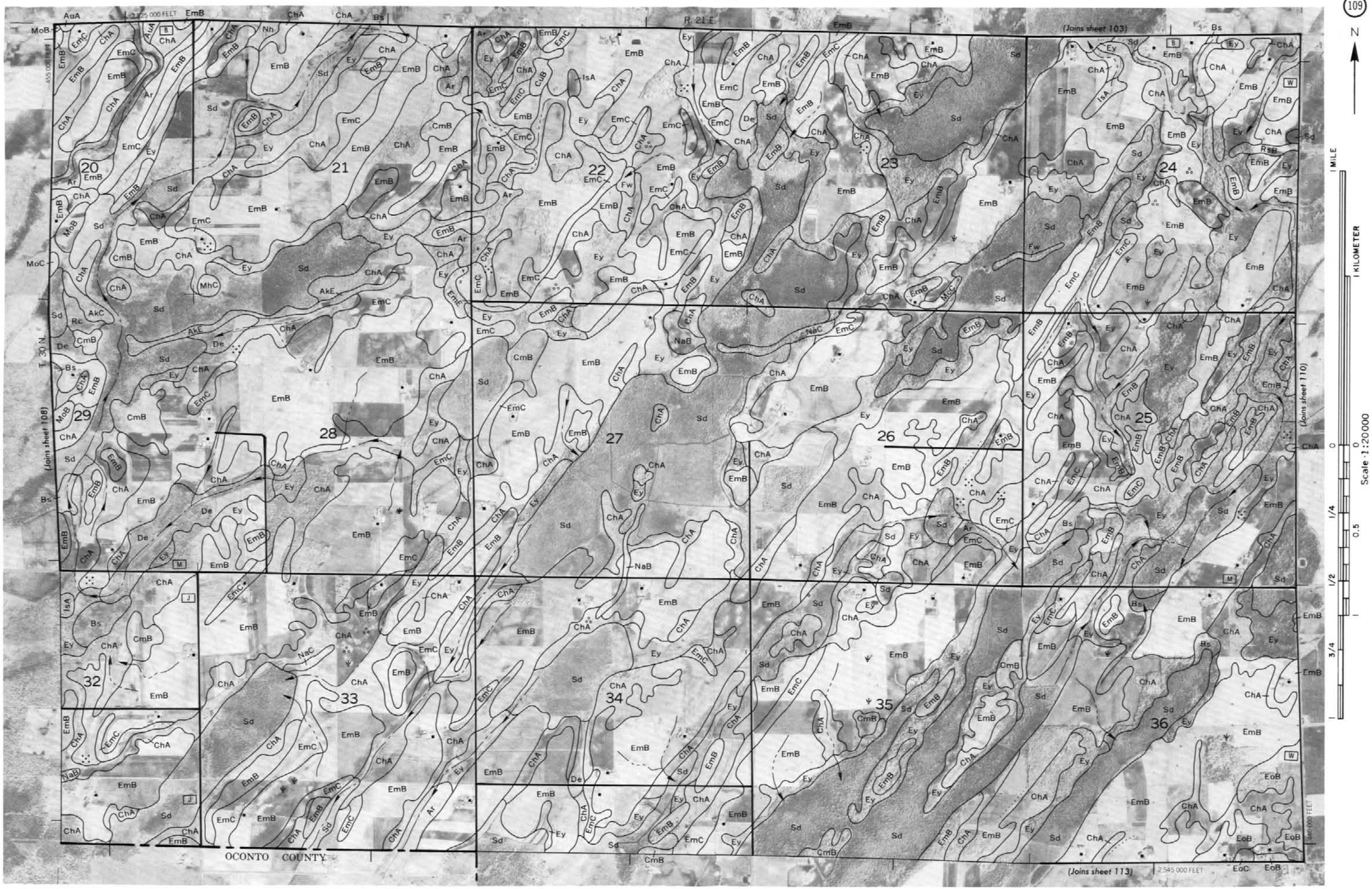

R. 19 E.
(Joins sheet 101)
(Joins sheet 95)
T. 31 N.
2 470 000 FEET
485 000 FEET
475 000 FEET
2 475 000 FEET
Mud Lake
Hosed Lake
Bahlert Lake
Whiskey Creek
Patz Landing Field
OCONTO COUNTY
19
20
29
30
31
32


107
R. 20 E.
(Joins sheet 101)
(Joins sheet 108)
T. 30 N.
2 480 000 FEET
455 000 FEET
440 000 FEET
2 550 000 FEET
Jones Lake
Jones Creek
School Creek
Little Peshtigo River
Montana Lake
Messenger Creek
OCONTO COUNTY
19
20
21
28
29
30
31
32
33
N
1 MILE
1 KILOMETER
Scale 1:20000

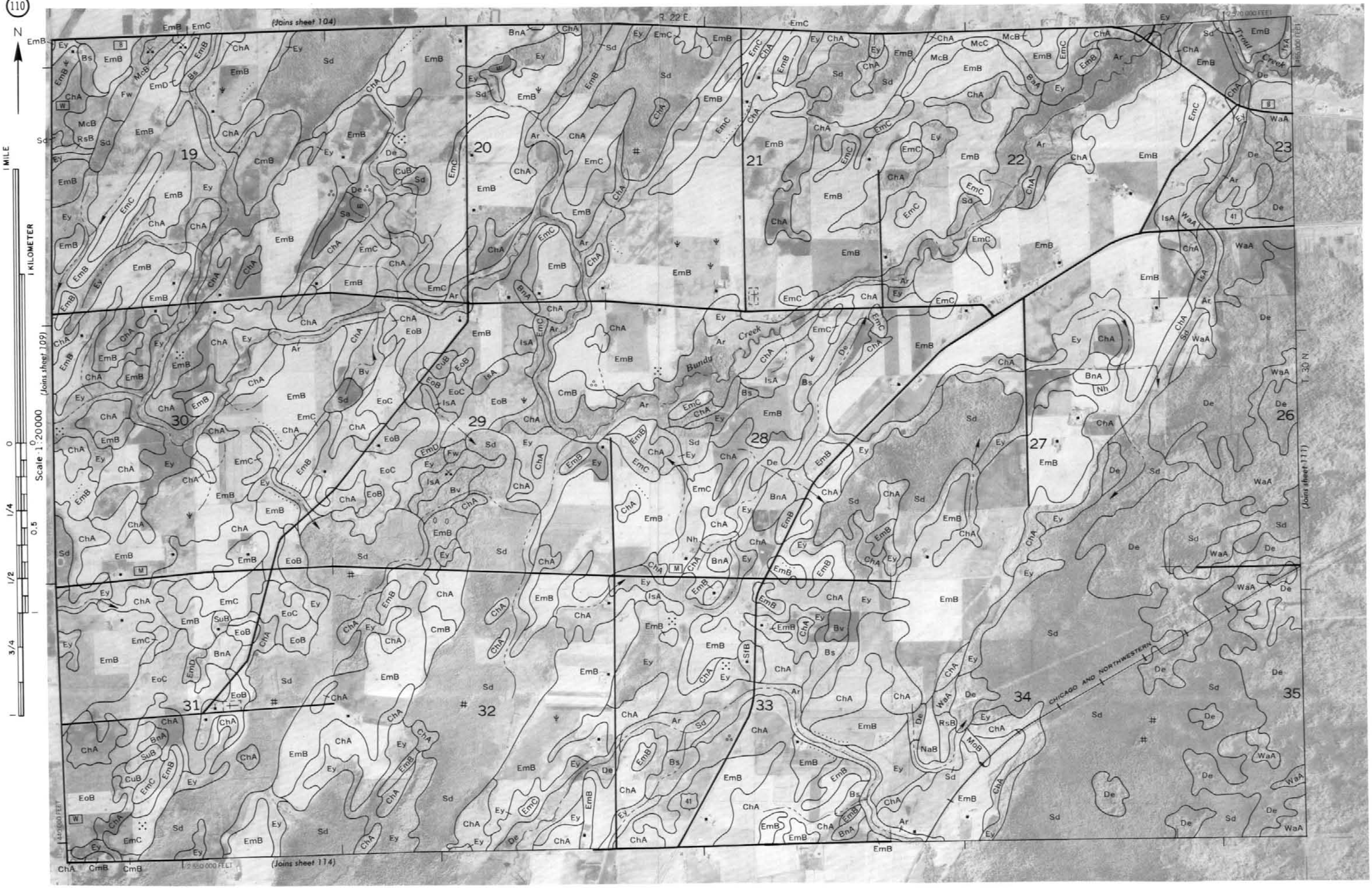
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 108



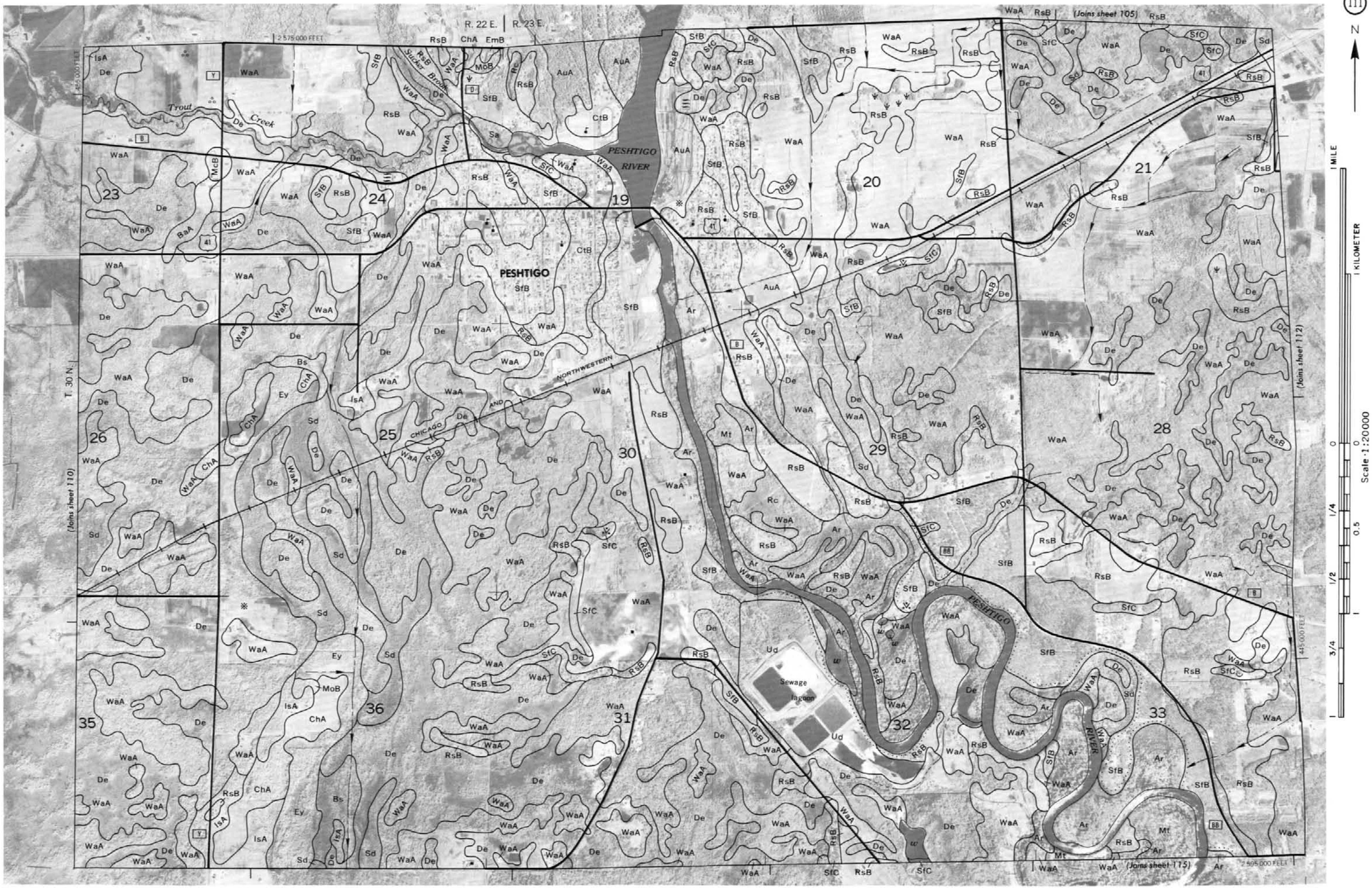
SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 109



SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 110

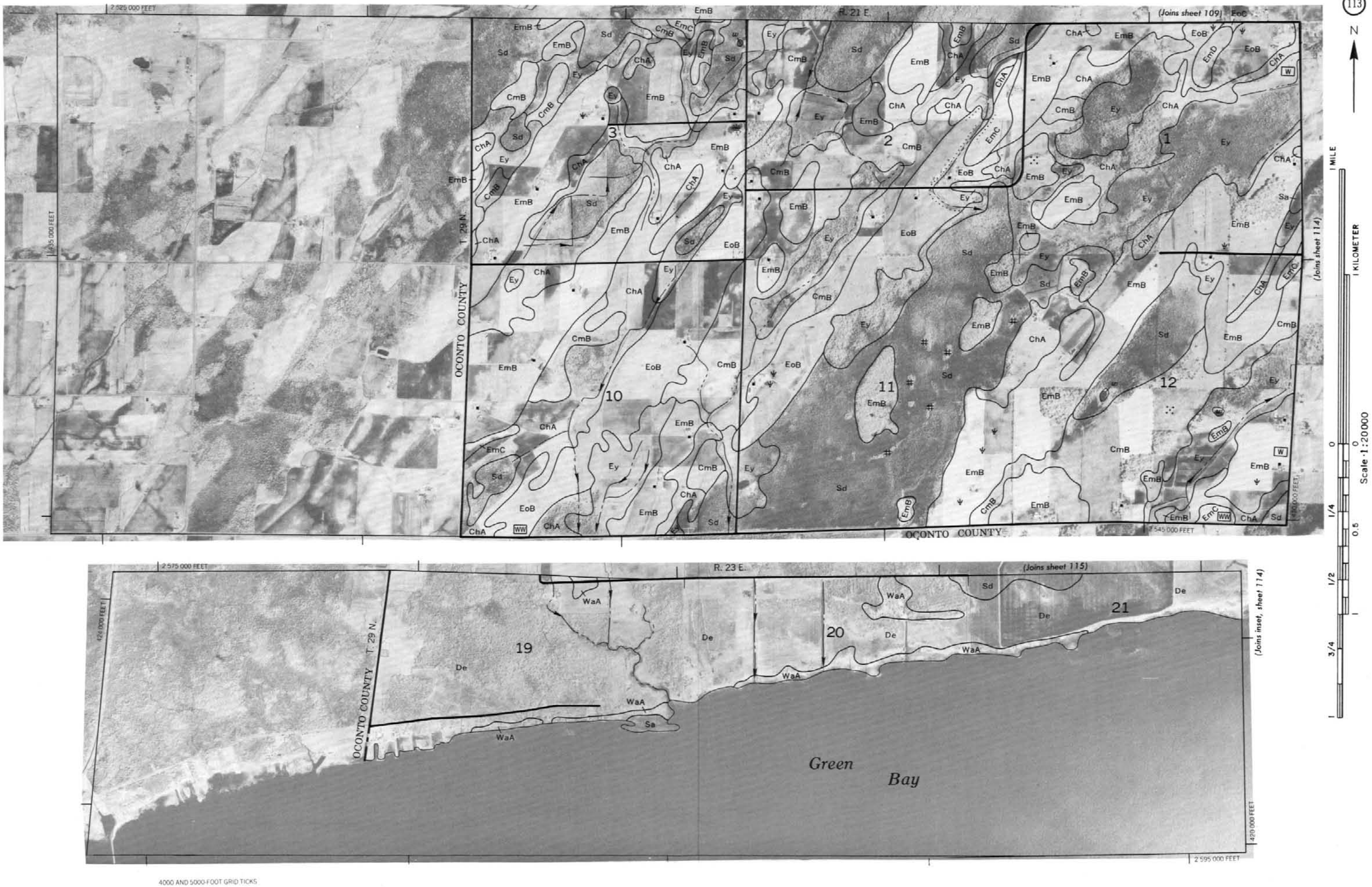


SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 111

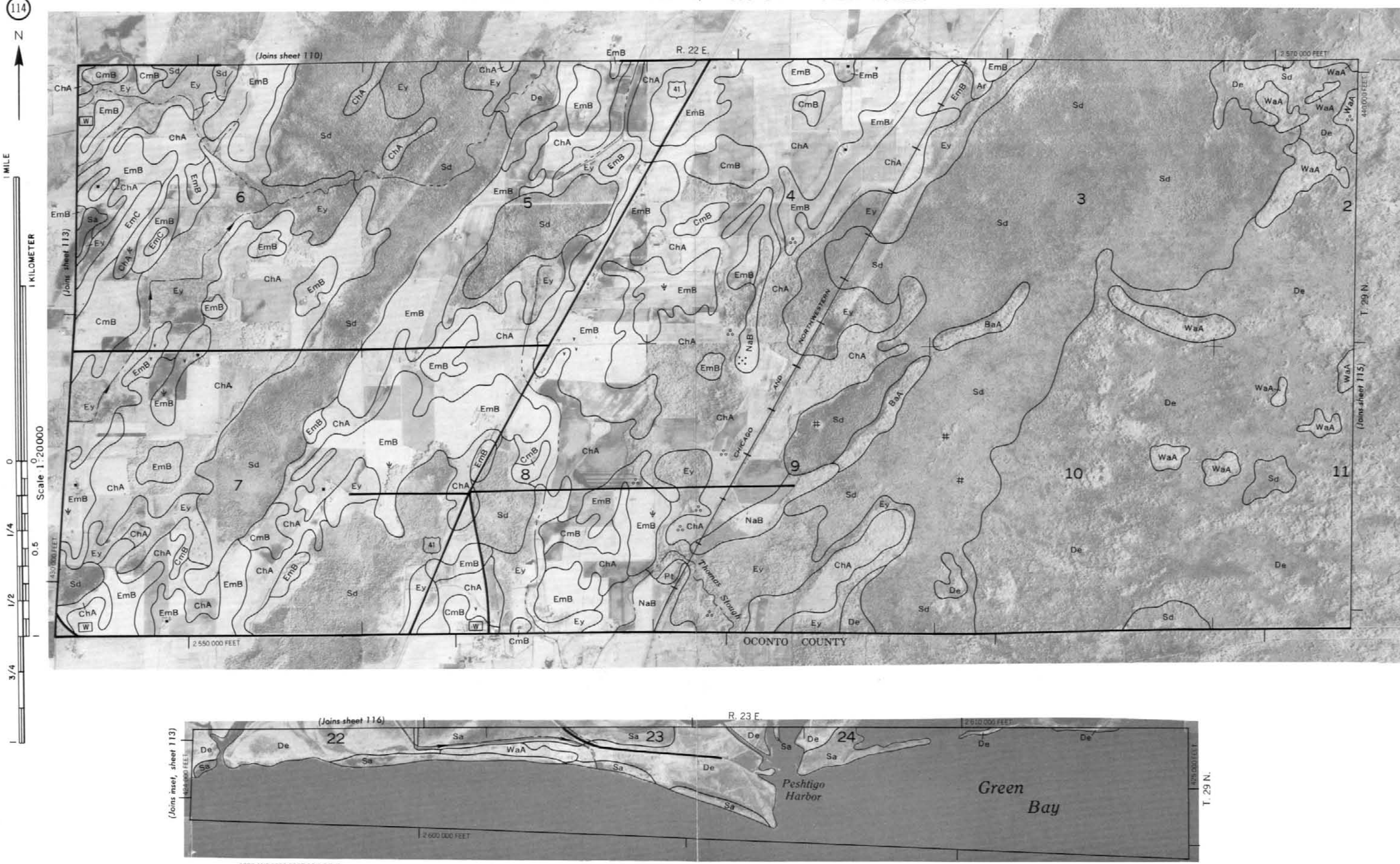



112
N
1 MILE
1 KILOMETER
Scale 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 106)
(Joins sheet 111)
(Joins sheet 116)
R. 23 E.
R. 24 E.
T. 30 N.
2 610 000 FEET
2 600 000 FEET
455 000 FEET
445 000 FEET
Green
Bay
Little
River
19
22
23
24
25
26
27
30
31
34
35
36
WaA
De
RsB
SfB
SfC
SfD
Sd
Sa
Ls
Pt
Ar
AuA
41
8
88

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 113



SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 114




115
R. 22 E.
R. 23 E.
T. 29 N.
(Joins sheet 111)
(Joins sheet 114)
(Joins sheet 116)
(Joins inset, sheet 113)
OCONTO COUNTY
PESHTIGO RIVER
PESHTIGO HARBOR STATE WILDLIFE AREA
N
1 MILE
1 KILOMETER
Scale 1:20 000
2 575 000 FEET
2 595 000 FEET
400 000 FEET

116

SOIL MAP OF MARINETTE COUNTY, WISCONSIN — SHEET NUMBER 116

N